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(54) Circular DIN electrical connector.

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Description

This invention relates to wire housings and contact housings for circular cross section electrical connectors for shielded electrical cables and in particular miniature DIN circular electrical connectors, which are of high contact density.

There is disclosed in US-A-4,723,916 a shielded, circular electrical connector comprising an insulating wire housing having a through axial bore from which radially extend a plurality of notches. The notches have slots associated therewith for receiving insulation displacing wire connecting portions, in the form of slotted plates, of contact elements supported by a mating, insulating contact housing. Insulated wire end portions of a shielded electrical cable are inserted through the bore of the wire housing from one end thereof and are dressed into the radial notches which are at the other end of the wire housing. Parts of the wire end portions which extend radially beyond the notches are trimmed at the radially outer ends of the notches. The two housings are then mated so that the slotted plate connecting portions of the contact elements of the contact housing are received in slots of the wire housing to make electrical contact with the wire end portions in the notches. A tubular shielding shell is then mated with the subassembly so provided to cover the contact housing but not the wire housing and an insulating boot is then fitted over both of the housings.

The housings are of sufficiently large cross-section in relation to the number of the contact elements to allow the contact elements, which are received in cavities of identical configuration, and the said slots, to be evenly distributed in the same array concentrically with the longitudinal axes of the housings. Neither of the housings is provided with a hood for receiving the other housing as the housings are being mated, the boot being relied upon to hold the housings in their mated relationship.

Although US-A-3,141,717 discloses a circular electrical socket comprising coplanar electrical contact elements, the planes of which are oriented in preselected positions relative to one another, none of said planes facing the longitudinal axis of the socket, the contact elements are arranged concentrically about said axis and the cavities in which they are received are of identical configuration.

US-A-3,274,530 describes an unshielded electrical connector of somewhat similar construction to the connector of US-A-4,723,916 and primarily intended for connecting the electrical cord of a telephone to the handset. It comprises a plug member in the form of a wire housing having an axial bore through which the cord extends and a series of axial grooves in an outer cylindrical surface portion at its mating end for receiving the wires of the cord which are folded onto the outer surface through associated radial notches in the mating end. A ring-like collar operates to hold the wires firmly in the grooves. The wire housing plugs into a shroud or hood at the mating end of a cooperating socket or contact housing having a plurality of contacts having insulation displacement portions for connecting with the wires of the wire housing.

The present invention is intended to provide a circular cross section electrical connector which may be completely shielded, which is easy to assemble and which may be of high contact density in relation to its cross-sectional area.

Accordingly, the present invention consists in a cylindrical electrical connector for terminating conductors of a multi-conductor cable, comprising a wire housing defining an axis and an outer cylindrical surface and having an axial bore extending therethrough from a cable receiving end,adapted to receive the multi-conductor cable therein, to a cable exit end and radially extending notches in said cable exit end, said notches extending from said bore to said outer cylindrical surface and a contact housing having a shroud with an interior cylindrical wall defining a cavity for receiving said wire housing and a plurality of contacts secured in the contact housing, said contacts each having a mating portion and an insulation displacement portion, and said insulation displacement portion extending into said cavity for termination to conductors of the multi-conductor cable, characterised by spacer means formed on the wire housing and the contact housing to position the wire housing transverse to the axis, the spacer means defining a space between the outer cylindrical surface of the wire housing, and the interior cylindrical wall of the contact housing for reception of ends of conductors of the multi-conductor cable, and means for securing the wire housing and the contact housing together.

In one embodiment of the invention, the wire housing is formed with a series of parallel external recesses or grooves each opening into one of the notches at one end of the wire housing and extending towards the other end thereof. The shroud or hood of the contact housing has a series of internal parallel grooves extending longitudinally thereof. The wire end portions, when dressed into the notches, are trimmed at positions which are disposed radially beyond the outer periphery of the wire housing. When the wire and contact housings are mated, guided by the hood, the radially outwardly extending trimmed ends of the wire end portions are received in and are fully enclosed by the walls of the grooves of the wire housing and the hood. The grooves thus constitute half channels which co-operate to provide wire channels when the housings are mated. The wire housing is preferably formed with a collar surrounding the end thereof which is remote from the notches. The free end of the hood of the contact housing is formed with notches opening thereinto for gathering in the radially projecting parts of the trimmed wire end portions as

the housings are being mated, the free end of the hood abutting the collar in the fully mated condition of the housings.

Since the trimmed wire ends are fully enclosed between the hood and the wire housing, the sub-assembly comprised by the mated housings can be completely surrounded by a shielding shell without the risk of said wire ends touching the shell.

For ready handling of the housings when loading the wire housing with the wire end portions and when mating the housings, each housing is provided with a handling tab which projects radially outwardly thereof and which can be broken away therefrom inboard of the cylindrical profile of the housing when the mated housings are to be inserted into the shielding shell. When mating the housings, the handling tabs thereof are positioned in alignment to correctly angularly orient the housings relative to each other so that each wire connecting portion is aligned with the correct slot in the wire housing. In order to avoid the presence of plastics material burrs which would interfere with the full mating of the housings, the said collar is preferably formed with opposed peripheral flats.

High contact density is achieved by a judicious distribution of the cavities containing the contact elements throughout the cross-section of the contact housing. The cavities and the contact elements are configured so that the slotted plate wire connecting portions are positioned and oriented for insertion into the slots of the wire housing, which are distributed proximate to its outer periphery, and which are not necessarily all concentric with the longitudinal axis of the wire housing.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which:

FIGURE 1 is an enlarged isometric, exploded view of a miniature circular DIN plug assembly according to an embodiment of the invention, comprising a wire housing, a contact housing and a shielding shell;

FIGURE 2 is an enlarged exploded view, in longitudinal section, showing the wire housing, the contact housing and contact elements thereof;

FIGURE 3 is an enlarged isometric exploded view showing the said housings and contact elements;

FIGURE 4 is an enlarged longitudinal sectional view illustrating how the contact housing is assembled to the wire housing when the latter has been loaded with wires of a shielded cable;

FIGURE 5 is an enlarged isometric view illustrating a step in the assembly of the wire and socket housings to the shielding shell;

FIGURE 6 is an enlarged isometric rear view of the shielding shell with the housings inserted thereinto;

FIGURES 7 and 8 are enlarged, fragmentary rear views illustrating a further step in the assembly of the housings to the shielding shell;

FIGURE 9 is an enlarged isometric, frontal view showing the miniature DIN plug assembly in its fully assembled state;

FIGURES 10, 11 and 12 are, an enlarged front end view, an enlarged side view, shown partly in section, and an enlarged rear end view, respectively, of the contact housing;

FIGURES 13 to 16 are enlarged elevational views of respective contact elements of the contact housing;

FIGURE 17 is a view of either of the contact elements shown in Figures 15 and 16, taken in the direction of the arrow 17 in each of these Figures;

FIGURE 18 is an enlarged top view of a contact element receiving cavity shown in Figure 12;

FIGURE 19 is a view taken on the lines 19-19 of Figure 18;

FIGURE 20 is a top plan view of another contact element receiving cavity shown in Figure 12;

FIGURE 21 is a view taken on the lines 21-21 of Figure 20;

FIGURE 22 is a view taken on the lines 22-22 of Figure 21;

FIGURES 23 to 26 are enlarged rear end views of a three position, a four position, a five position, and a six position, contact housing, respectively;

FIGURE 27 is an enlarged side view, shown partly in section, of the wire housing;

FIGURE 28 is an enlarged top plan view of the wire housing;

FIGURES 29 and 30 are views taken on the lines 29-29 and 30-30 respectively of Figure 28;

FIGURES 31 and 32 are a front view and a side view, respectively, illustrating a step in the manufacture of a series of the contact housings;

FIGURES 33 and 34 are an enlarged side view and an enlarged end view, respectively, of a miniature DIN plug assembly having an alternate embodiment shielding shell;

FIGURES 35 to 40 are isometric views illustrating respective steps in a method of manufacturing a sub-assembly of the miniature DIN plug assembly; and

FIGURES 41 to 43 are fragmentary sectional views illustrating some respective steps of said method, in detail.

An eight position DIN circular cross section plug assembly and the manner in which its components are assembled to a multi wire shielded cable will now be described with reference to Figures 1 to 9. As shown in Figure 1, the assembly comprises three components, that is, an insulating, wire housing 10, an insulating, contact housing 12, and a metal shielding shell 14. The wire housing 10 is tubular, defining a bore 16 which is of circular cross section, having a substantially constant cross section, forward, wire re-

ceiving part 18 opening into a rearward cable end receiving, rearwardly flared, guide mouth 20, as best seen in Figure 2. The bore parts 18 and 20 co-operate to define a stop shoulder 19. The mouth 20 is surrounded by a rearward, collar 22 formed with opposed flats 24 but being otherwise of circular cross section. The wire receiving part 18 of bore 16 is defined by a circular wall 26 extending normally of collar 22. The inner surface 27 defines bore 16. Outer surface 25 is formed with eight parallel, wire receiving grooves 28 substantially equally spaced around the periphery of wall 26. Grooves 28 open into a mating forward end 30 of the housing 10. Each groove 28 intersects and communicates with a respective transverse radially extending wire receiving notch 32 which defines base 33 in forward end 30. Grooves 28 thus communicate with wire receiving part 18 of bore 16. In line with each notch 32 and extending through base 33 and the sides thereof, wall 26 is formed with a slot 34 for receiving a wire connecting portion of a contact element secured in housing 12. Each slot 34 has a flared, guiding mouth 36 opening into the mating face 30.

The contact housing 12 comprises a substantially cylindrical dielectric block 38 formed with eight contact element-receiving, through cavities 40, the configurations of some of which differ from one another, as described in detail below, each for receiving the electrical contact element 42, some of which also differ from one another, as described in detail below. Each cavity 40 opens at one end, into a forward mating face 44 of the block 38 and into a rear mating face 46 thereof. The face 46 has projecting rearwardly therefrom, a cylindrical hood 48 surrounding the face 46 defining concentric cylindrical inner wall 47 and outer wall 49. Within inner wall 47 is cylindrical cavity 51 sized to receive the wire housing 10. Hood 48 extends to rearward edge 50 into which open eight radially extending wire receiving notches 52. The block 38 is also formed with three keyways 54 which open into the face 44. The keyways cooperate with structure on a mating connector to assure proper orientation prior to mating. The hood 48, which is of somewhat larger diameter than block 38, defines an inclined peripheral stop surface 56 extending thereabout. The internal surface of the hood 48 is formed with parallel, wire receiving grooves 58 each extending from the rear face 46 of block 38 and opening into a respective notch 52. Grooves 58 are recessed into inner wall 47 parallel to the axis of cylindrical block 38 and spaced around the periphery of inner wall 47 to correspond to the spacing of grooves 28 around the wire housing. In the preferred embodiment, grooves 58 are substantially equally spaced around the periphery.

Outer surface 25 of wire housing 10 between adjacent grooves 28 forms ribs 23 to engage the inner wall 47 of contact housing 12. Ribs 23 position wire housing 10 transverse to the axis within cavity 51 in contact housing 12. Radially outwardly directed ribs 23 also provide a space between the wire housing and the contact housing to receive the ends of conductors.

Hood 48 has between adjacent grooves 58 radially inwardly directed rib means 53 to engage either ribs 23 or outer surface 25, whichever is present of wire housing 10 to position wire housing 10 transverse to the axis within cavity 51 in contact housing 12. Ribs 53 provide a space between the wiring housing and the contact housing to receive the ends of conductors.

Grooves 28 and 58 are each recessed into cylindrical surfaces. Each groove receives a chordal cross section of a wire W. Typically neither groove 28 nor groove 58 of a pair of cooperating grooves receives more than about half of the cross section of a wire W received therein. A pair of grooves 28 and 58, in the preferred embodiment, cooperate to provide a wire receiving channel.

Each contact element 42 comprises a mating portion in the form of a pin 60, a serrated anchoring portion 62 and a wire connecting portion 64 having a wire receiving slot 66, the wire connecting portion 64 being connected to the anchoring portion 62 by way of a transition portion 68. The transition portion 68 of some of the contact elements 42 are differently configured as shown in Figure 3, for reasons explained below.

The housing 12 is loaded with the contact elements 42, by inserting each contact element 42 with its pin 60 leading, by way of the hood 48, into a respective cavity 40 so that, as shown in Figure 4, the anchoring portion 62 of each contact element 42 and the rear part of the pin 60 thereof are received in a constricted portion 70 of the respective cavity 40. Serrations 72 on the portion 62 bite into the walls of the cavity portion 70 in block 38 thereby to retain the contact element 42 therein, with the pin 60 thereof projecting from the mating face 44 of the block 38 and the wire connecting portion 64 of the contact element 42 projecting from the mating face 46 of the block 38.

The shielding shell 14 is tubular and is of circular cross section and comprises a smaller cross section forward part 74 and a larger cross section rear part 76 defining a stop shoulder 78 which is complementary with the shoulder 56 of the housing 12. The part 74 is formed with internal longitudinal forward keys 80 and with shorter internal rear keys 82, each in line with a respective key 80, the part 76 being formed rearwardly thereof with internal keys 84 each in line with a pair of respective keys 80 and 82. The shell 14 has a forward edge 86 and rear edge 88. There project from the rear edge 88, a pair of opposed crimping lugs 90 of substantially semi-circular shape and being connected to the edge 88 by way of necks 92, the lugs 90 having braid engaging inner edges 91.

In order to load the wire housing 10 with wires, an end portion of a shielded, multiwire electrical cable C is stripped to expose the insulated wires W thereof, which in the present example, are eight in number, as well as an end portion of the metallic braid shield BS of the cable C, which shield BS is then folded back. The wires W are inserted through the bore part 18, guided by the mouth 20, until the jacket and shield abut against stop shoulder 19. The wires W are then laced into respective radial notches 32, to lie on the bases 33 thereof so as to be dressed over the slots 34, as shown in Figure 4. The contact housing 12 loaded with contact elements 42, as described above, is axially aligned with wire housing 10, and then one or both of the housings are moved toward each other until mated, such as by moving housing 10 in the direction of the arrow A in Figure 4 so that the wall 26 of the housing 10 is received in the hood 48 of the housing 12. The relative movement of the wire housing and contact housing effects termination of conductors of cable C to respective contact elements. The wire connecting portion 64 of each contact element 42 enters a respective slot 34 in the wall 26 guided by the mouth 36 of the slot 34 so that the portion of each wire extending across the slot 34 is received in the wire receiving slot 66 of a respective wire connecting portion 64 whereby the edges of the slot 66 displace the insulation of the wire W so as to make permanent conductive contact with the metal core of the wire W. Each wire W is sheared off at a shear plane SP before the wire W is engaged by the respective wire connecting portion 64. As the housings 10 and 12 are being mated, the walls of the grooves 58 of the housing 12 force those parts of the wires W which lie outwardly of outer surface 25 of wall 26, into the grooves 28, whereby the half channels defined by the grooves 28 and 58 cooperate to enclose said parts of the wires, so that their sheared ends lie facing the collar 22. Part of the folded back end part of the shield BS lies in the flared mouth 20.

The sub-assembly 94 provided by the assembled housings 10 and 12, is now axially aligned with the shell 14, as shown in Figure 5, with the face 44 of the housing 12 directed towards the edge 88 of the shell 14. Shell 14 is typically stamped and formed. The sub-assembly 94 is so angularly oriented with respect to the shell 14, that each keyway 54 of the former, is aligned with the aligned keys 82 and 84 of the latter. The sub-assembly 94 is then inserted into the shell 14 guided by co-operation between the keyways 54 and keys 82 and 84 until the stop shoulders 56 and 78 are in abutment. In this fully seated or mated position of the sub-assembly 94 and the shell 14, which is shown in Figure 6, the lugs 90 are crimped over, as indicated by the arrows D in Figures 7 and 8 so that they engage the collar 22, ends 93 of each lug 90 are pressed toward each other such that inner edges 91 of the lugs 90 firmly engage the braid shield BS of the cable C making electrical and mechanical contact therewith and providing strain relief. The sub-assembly 94 is thus secured within the shell 14, against all movement with respect thereto, by virtue of the cooperation between the said keys and keyways, the abutment shoulders 56 and 78, the lugs 90 and the collar 22, the shell 14 being electrically commoned with the braid shield BS by means of the lugs 90. The part of the folded back end of the shield BS, which projects beyond the lugs 90, is then severed. The completed miniature circular DIN plug assembly is shown in Figure 9 with the pins 60 of the contact elements 42 projecting into the part 74 of the shell 14 for mating with sockets of a DIN socket assembly (not shown), having keyways for receiving the keys 80. Since the outer portions of the wires W are snugly enclosed by the walls of the grooves 28 and 58, with the sheared ends of the wires W facing the collar 22, the wires W cannot be grounded by electrical connection with the shielding shell 14.

The assembly shown in Figure 9 can, since it is fully surrounded by the shell 14, safely be encapsulated to provide an overmolded insulating handle 99 (shown in phantom) covering the crimped connection for the plug assembly, since the encapsulating resin cannot to any significant extent reach the sub-assembly 94 in the shell 14.

For absolute protection of the sub-assembly 94 against the encapsulating resin, the lugs 90 may be omitted from the shell 14', which is a seamless drawn shell, as shown in Figures 33 and 34, and the rear end portion of the part 76' thereof may be crimped firmly about the braid shield BS of the cable C by means of indenting tooling (not shown) providing a star shaped crimp, best seen in Figure 34. The shell 14' is designed for crimping to multiple different diameters of cable to provide electrical continuity with the braid and strain relief to the cable.

The wire housing 10 will now be described in greater detail with reference to Figures 27 to 30. As shown in Figures 27 and 28, the housing 10 is provided with a handling tab 100 parallel to the flats 24 to facilitate handling the housing 10 in a preferred method of assembling it to the housing 12, which is described in detail below. The tab 100 is connected to the collar 22 of the housing 10 by a reduced cross section portion 102 which is formed integrally with a further flat 104 on the collar 22 and which can be broken off therefrom at a position which is slightly inward of the arcuate outer periphery of the collar 22, by virtue of the flat 104. Proximate to its end opposite to the portion 102, the tab 100 has a depending leveling extension 106 projecting below the housing 10, as shown in Figure 27. As shown in Figure 28, the slots 34 are distributed about the center of the housing 10 inwardly of the outer surface 25 of the wall 26. Six of the slots 34 are equally spaced from the center of the housing 10 but two other slots, which are referenced 34' are

spaced from the center of the housing 10 by a slightly greater distance. As best seen in Figures 29 and 30, notches 32 are of sufficient depth to enable the wires W to be dressed thereinto so that they do not protrude above mating face 30 of the housing 10, thereby ensuring that contact housing 12 will seat properly on the housing 10 when it is assembled thereto as described above.

The contact housing 12 will now be further described with reference to Figures 10 to 19. As shown in Figure 10, the pins 60 of the contact elements 42 are, according to a DIN standard, required to be located at predetermined positions with respect to the center of the housing 12 but not in the same array as the slots 34 and 34' of the housing 10 and to be closely spaced it will be apparent from Figure 10 and 12 that the standard requires a high contact density. The contact positions are numbered 1 to 8 in Figures 10 and 12. Typically from three to eight positions receive contact elements. It will be apparent from a comparison of Figures 10 and 28, that each contact element must be configured so that its wire connecting portion 64 enters a respective slot 34 or 34', as the case may be, when the housings 10 and 12 are mated, and to this end, rear portions 108a, 108b, 108c and 108d of the cavities 40 in the block 38, which portions receive the transition portions 68 of the contact elements 42, must be differently configured as shown in Figure 12. The contact elements 42, which are referenced 42a to 42d in Figures 3 and 13 to 17, have differently configured transition portions 68 which are referenced 68a of the contact elements 42a, and which are to be received in the cavities 40 at the positions 1, 2, 5, and 8 (see Figure 10) and are shaped to offset the wire connecting portion 64 of the contact element 42a laterally leftwardly from the pin 60 thereof, as shown in Figure 13. The transition portions 68b of contact elements 42b for reception in the cavities 40 at the positions 3 and 6 are shaped to offset the wire connecting portion 64 from the pin 60 rightwardly as shown in Figure 14. These offsets provide that the center of wire receiving slot 66 is laterally spaced from the axis of pin 60 in contact elements 42a and 42b. As shown in Figure 15, the transition portion 68c of the contact element 42c for reception in the cavity 40 at position 4 is shaped to offset the wire connecting portion 64 of the contact element 42c from its pin 60 by a substantial distance rightwardly out of the plane of the pin 60, or equivalently pin 60 out of the plane of wire connection portion 64, since position 4 is spaced a commensurate distance inwardly of the periphery of the face 46 of the housing 12 shown in Figure 12. As shown in Figure 16, the transition portion 68d of the contact element 42d for reception in the cavity 40 at position 7 serves similarly to offset the wire connecting portion 64 of the contact element rightwardly of the plane of the pin 60, or equivalently pin 60 out of the plane of wire connecting portion 64, by a lesser distance than does the portion 68c of the contact element 42c, since position 7 is nearer to the periphery of the face 46 than position 4. Figure 17 shows either of the contact elements 42c and 42d from a position at right angles to the plane the wire connecting portion 64. It will be apparent from the foregoing that contact elements 42a and 42b are coplanar whereas the contact elements 42c and 42d are not. Each contact element 42a to 42d is provided between its transition portion and its wire connecting portion 64, with a pair of locating wings 69.

Figures 18 and 19 show one of the cavity portions 108a at positions 1, 2, 5 and 8. The cavity portions 108b at positions 3 and 6 are of the same shape as the cavity portions 108a but are oriented in mirror image relationship with respect thereto. Each cavity portion 108a and 108b comprises a slot 110 for the transition portion 68a or 68b as the case may be, and the locating wings 69.

Figures 20 to 22 show the cavity portion 108c at position 4, which comprises an elongate slot 112 extending radially outwardly of the cavity portion 70, with which it communicates, for receiving the transition portion 68c of the contact element 42c and terminating in a transverse slot 114 extending normally of the slot 112 for receiving the locating wings 69 of that contact element. The cavity portion 108d (Figure 12) is similar to the cavity portion 108c but has an elongate slot 116 which is shorter than the slot 112, for receiving the transition portion 68d of the contact element 42d and which terminates in a transverse slot 118 extending normally of the slot 116 for receiving the locating wings 69 of the contact element 42d.

As will be apparent from Figure 12, the slots 110 of the cavity portion 108a and 108b at positions 3 and 5 extend parallel to a longitudinal central plane P-P (Figures 10 and 11) of the housing 12, the slots 110 of the cavity portions 108a and 108b at positions 6 and 8 being angled with respect to the plane P-P by 50°, and the slot 110 of the cavity portion 108a at position 2 being angled by 60° with respect to the plane P-P and the slot 110 of the cavity portion 108a at position 1 being angled by 70° with respect to the plane P-P. The slot 114 of the cavity portion 108c at position 4 is angled by 40° with respect to the plane P-P. The slot 118 of the cavity portion 108d at position 7 is angled by 90° with respect to the plane P-P. The slot 112 is angled by 50° with respect to the plane P-P and the slot 116 by 0° with respect thereto. The wire connecting portions 64 of the contact elements 42a to 42d at the positions mentioned above are angled with respect to the plane P-P in the same way as the respective transverse slots receiving the wings 69, so as to conform with the positioning of the respective slots 34 and 34' in the wall 26 of the wire housing 10.

For use in assembling the contact housing 12 to the housing 10, the housing 12 is provided with a handling tab 120 frangibly connected by way of a reduced

cross-section portion 124, to a flat 122 adjacent to the edge 50 of the hood 48. The tab 120 is the same as the tab 100 excepting that it is not provided with a projecting spigot.

Figures 23 to 25 show, in top plan view, respective embodiments 12a to 12d of the contact housing, having three, four, five and six contact element positions respectively numbered 1 to 6, the cavity portions at these positions being referenced as in Figure 12 and each cavity portion being configured and angled in the same way as a corresponding cavity portion of the housing 12. Thus each of the contact housings 12a to 12d can be used with the same wire housing 10, the housing 10 being wired only in the respect of those slots 34 or 34' as the case may be, which correspond to the contact element positions provided in the mating housing 12a, 12b, 12c or 12d. The housings 12a to 12d could be identical, contact elements 42 being loaded only in those cavities that are shown in Figures 23 to 26, so that only two molds, for the respective housing 12 to 12d, need to be tooled.

As shown in Figures 31 and 32, housings 12, or for that matter housings 10, can be molded in groups of housings, groups of four housings according to the present example, the housings of each group being joined by slugs 126 of the housing material, which connect webs 120' thereof from which the tabs 120 of the housings are subsequently cut.

A practical method of manufacturing the sub-assembly 94 will now be described with reference to Figures 35 to 43.

Briefly stated, the press 150 comprises a frame 152; a ram housing 154; a ram 156 slidable vertically therein; a ram drive handle 158 coupled to the ram 156 by way of a shaft 160 and gear means (not shown); an applicator head 162 on the ram 156; a crown of light shear blades 164 (one of which is shown in Figure 41) depending from the head 162; a horizontal slideway 166 on the frame 152 having a base 167 formed with a longitudinal through slot 169; a slide 168 which is slidable along the slideway 166; a clamp 170 on the slide 168 having a movable part 172 and fixed part 174; a toggle mechanism 176 having an operating handle 178 for moving the part 172 towards and away from the part 174; and a hinge in the form of a two-part applicator nest 180 having a first half 182 on the part 172 and a second half 184 on the fixed part 174, having a vertical through slot 175. The nest 180 has a ring of blind slots 181 which open into its upper edge 182, and the bottom inner edges of which define shear edge 186. With the slide 168 secured at the end of the slideway 166 remote from the ram 156, the ram 156 being in a raised position, and the handle 178 being in a lowered position so that the clamp 170 and the nest 180 are both in an open position, as shown in Figure 35, the operator inserts a wire housing 10 into the open nest 180 by means of the handling tab 100 of the housing 10, the tab 100 being received in the slot 175 of the nest half 184 until the free end of the spigot 106 of the tab 100 engages a horizontal reference surface 188 of the slide 168 (as best seen in Figures 36 to 38) so that the housing 10 is correctly oriented and levelled with respect to the open nest 180 and so that it is correctly seated therein. The handle 158 is then raised to close the clamp 170 and thus the nest 180. The cable C having been stripped and having its braid shield BS folded back, as described above, the stripped end of the cable C is inserted from below, up through the slot 169 in the slide 166, so that wires W of cable C project upwardly from the mating face 30 of the housing 10, as shown in Figure 36, having been guided into the part 18 of the bore 16 by the frusto-conical wall of the mouth 20. In the fully inserted position of the cable C, the end of the braid shield abuts against the stop shoulder 19 between the bore parts 16 and 20. As shown in Figure 37, each wire end portion is then dressed, in a taut condition, into a respective predetermined notch 32 of the housing 10 so as to extend through a respective blind slot 181 and to bottom therein. As shown in Figure 41 there is substantial clearance between the nest 180 and the wall 26 of the housing 10.

As shown in Figure 38, the operator now takes up a housing 12, by its handling tab 120, and orients it above the housing 10 so that the tabs 100 and 120 are in alignment as shown.

The operator then lowers the housing 12 onto the housing 10 so that the wall 26 of the latter is received partially in the hood 48 of the former, the tab 120 of the housing 12 being received in the through slot 175 of the nest 180, thereby ensuring that the tabs 100 and 120 are in precise alignment so that the housings 10 and 12 are correctly angularly oriented with respect to each other (Figure 38). It must be ensured by means of the levelling spigot 106 that the housings are level, with no noticeable degree of tilt.

With the housings 10 and 12 so relatively positioned, the slide 168 is advanced by the operator, as shown in Figure 39, towards the ram 156 until the housing 12 lies directly beneath the applicator head 162 when the slide 168 has been arrested by a stop (not shown). The operator then raises the handle 158 so as to depress the ram 156 towards the slide 168 so that each wire 10 is trimmed between a respective shear blade 164 and a respective shear edge 186 as shown in Figure 41. As the ram 156 advances further, the hood 48 of the housing 12 forces the severed end portion SP' of each wire 10 down into the corresponding groove 28 of the housing 10 and as shown in Figures 42 and 43, the severed end portion SP' is fully enclosed in the channel defined by the walls of the grooves 28 and 58. Also, as will be apparent from Figures 42 and 43, the wire connecting portion 64 of each contact element is forced through the part of the wire 10 which lies on the base 33 of the respective notch 32, into the part of the slot 34 there beneath,

whereby the edges of the slot 66 in the wire connecting portion 64 cut through the insulation of the wire 10 and make permanent electrical contact with the metal core thereof. The edge 50 of the hood 48 bottoms against the collar 22 of the housing 10 when the housings 10 and 12 have been fully assembled to provide the sub-assembly 94. The flats 24 prevent a burr of the housing material from inhibiting complete closure of the tooling about the housing 10.

The operator now depresses the handle 158 thereby raising the ram 156 and retracting the slide 168 to its initial position, lowers the handle 178 to separate the two halves 182 and 184 of the nest 180 and removes the sub-assembly 94 therefrom by means of the handling tabs 100 and 120.

As indicated in Figure 40, the operator manipulates the handling tabs 100 and 120 so as to break them from their respective housings at their respective reduced cross-section portions 102 and 104.

The sub-assembly 94 so stripped of its tabs 100 and 120 is assembled to the shielding shell 14 as described above with reference to Figures 5 to 9, or to the shielding shell 14' as described with reference to Figures 33 and 34.

While the preferred embodiments have been described with reference to a pin contact, the invention is not limited thereto and a socket or other type of known contact could be used. While the wire and contact housings have been described as being held together by the shielding shell, other means could be used for securing the wire and contact housings, such as a resilient latch on one housing riding over a ramp to latch behind a shoulder on the other housing. This would be particularly employed in unshielded connectors which may require a shroud extending from the forward portion of the contact housing.

Claims

1. A cylindrical electrical connector for terminating conductors of a multi-conductor cable (C), comprising a wire housing (10) defining an axis and an outer cylindrical surface (25) and having an axial bore (16) extending therethrough from a cable receiving end, adapted to receive the multi-conductor cable (C) therein, to a cable exit end (30) and radially extending notches (32) in said cable exit end (30), said notches (32) extending from said bore to said outer cylindrical surface (25) and a contact housing (12) having a shroud (48) with an interior cylindrical wall (47) defining a cavity (51) for receiving said wire housing (10) and a plurality of contacts (42) secured in the contact housing, said contacts (42) each having a mating portion (60) and an insulation displacement portion, and said insulation displacement portion (64) extending into said cavity (51) for termination to conductors (W) of the multi-conductor cable (C), characterised by spacer means (23,53) formed on the wire housing (10) and the contact housing (12) to position the wire housing (10) transverse to the axis, the spacer means (23,53) defining a space between the outer cylindrical surface (25) of the wire housing and the interior cylindrical wall (47) of the contact housing for reception of ends of conductors (W) of the multi-conductor cable (C), and means (14) for securing the wire housing (10) and the contact housing (12) together.

2. An electrical connector as recited in claim 1, characterised in that the spacer means comprise ribs (23) on the outer surface (25) of the wire housing (10), said ribs (23) engaging the interior wall (47) of the contact housing (12) upon insertion of the wire housing (10) into the cavity.

3. An electrical connector as recited in claim 1 or 2, characterised in that the spacer means (23,53) comprise radially inwardly directed ribs (53) extending from the interior wall (47) of the contact housing (12), said inwardly directed ribs (53) engaging the outer surface (25) of the wire housing (10) upon insertion of the wire housing (10) into the cavity (51).

4. An electrical connector as recited in claim 2 or 3, characterised in that adjacent ribs (23,53) define therebetween channel means adapted to receive an end of a conductor (W) from the multi-wire cable (C), each such channel means intersecting an associated notch (32).

5. An electrical connector as recited in claim 1, 2 or 3, characterised in that the wire housing (10) includes wire receiving recesses (28) in said outer surface (25), said wire receiving recesses (28) extending parallel to said axis and intersecting said notches (32) at one end thereof.

6. An electrical connector as recited in any preceding claim, characterised in that the means for securing the wire housing (10) and contact housing (12) together is a shielding shell (14).

Patentansprüche

1. Zylindrischer elektrischer Verbinder zum Anschließen von Leitern eines Mehrleiterkabels (C) mit einem Drahtgehäuse (10), das eine Achse und eine äußere zylindrische Oberfläche (25) definiert und eine axiale Bohrung (16) hat, die sich durch dieses hindurch von einem Kabelaufnahmeende her erstreckt und zur Aufnahme des

Mehrleiterkabels (C) darin geeignet ist und die sich bis zu einem Kabelaustrittsende (30) erstreckt, wobei sich radial erstreckende Kerben (32) in dem Kabelaustrittsende (30) vorgesehen sind, wobei die Kerben (32) sich von der Bohrung zu der äußeren zylindrischen Oberfläche (25) erstrecken, und wobei ein Kontaktgehäuse (12) eine Abdeckung (48) mit einer inneren zylindrischen Wand (47) hat, die einen Hohlraum (51) zur Aufnahme des Drahtgehäuses (10) definiert, und wobei eine Vielzahl von Kontakten (42) in dem Kontaktgehäuse angebracht ist, wobei die Kontakte (42) jeweils einen Fügeabschnitt (60) und einen Isolationsverlagerungsabschnitt haben und der Isolationsverlagerungsabschnitt (64) sich in den Hohlraum (51) zum Anschließen an Leitern (W) des Mehrleiterkabels (C) erstreckt, **gekennzeichnet** durch Abstandsmittel (23, 53), die an dem Drahtgehäuse (10) und an dem Kontaktgehäuse (12) ausgebildet sind, um das Drahtgehäuse (10) quer zu der Achse zu positionieren, wobei die Abstandsmittel (23, 53) einen Raum zwischen der äußeren zylindrischen Oberfläche (25) des Drahtgehäuses und der inneren zylindrischen Wand (47) des Kontaktgehäuses zur Aufnahem von Enden von Leitern (W) des Mehrleiterkabels (C) bilden, sowie durch Mittel (14) zum Befestigen des Drahtgehäuses (10) und des Kontaktgehäuses (12) miteinander.

2. Elektrischer Verbinder nach Anspruch 1, dadurch **gekennzeichnet**, daß die Abstandsmittel Rippen (23) an der äußeren Oberfläche (25) des Drahtgehäuses (10) aufweisen, wobei die Rippen (23) nach dem Einsetzen des Drahtgehäuses (10) in den Hohlraum an der inneren Wand (47) des Kontaktgehäuses (12) angreifen.

3. Elektrischer Verbinder nach Anspruch 1 oder 2, dadurch **gekennzeichnet**, daß die Abstandsmittel (23, 53) radial nach innen gerichtete Rippen (53) aufweisen, die sich von der inneren Wand (47) des Kontaktgehäuses (12) her erstrecken, wobei die nach innen gerichteten Rippen (53) nach dem Einsetzen des Drahtgehäuses (10) in den Hohlraum (51) an der äußeren Oberfläche (25) des Drahtgehäuses (10) angreifen.

4. Elektrischer Verbinder nach Anspruch 2 oder 3, dadurch **gekennzeichnet**, daß benachbarte Rippen (23, 53) zwischen sich Kanäle bilden, die zur Aufnahme eines Endes eines Leiters (W) von dem Mehrleiterkabel (C) geeignet sind, wobei jeder solche Kanal eine zugehörige Kerbe (32) schneidet.

5. Elektrischer Verbinder nach Anspruch 1, 2 oder 3, dadurch **gekennzeichnet**, daß das Drahtgehäuse (10) Drahtaufnahmeausnehmungen (28) in der äußeren Oberfläche (25) aufweist, wobei die Drahtaufnahmeausnehmungen (28) sich parallel zu der Achse erstrecken und die Kerben (32) an einem Ende schneiden.

6. Elektrischer Verbinder nach einem vorhergehenden Anspruch, dadurch **gekennzeichnet**, daß das Mittel zum Befestigen des Drahtgehäuses (10) und des Kontaktgehäuses (12) miteinander eine Abschirmhülse (14) ist.

Revendications

1. Connecteur électrique cylindrique pour la terminaison de conducteurs d'un câble (C) à conducteurs multiples, comportant un boîtier (10) de fils définissant un axe et une surface cylindrique extérieure (25) et ayant une lumière axiale (16) s'étendant à travers lui depuis une extrémité de réception de câble, destinée à recevoir le câble (C) à conducteurs multiples, jusqu'à une extrémité (30) de sortie de câble, et des encoches (32) s'étendant radialement dans ladite extrémité (30) de sortie de câble, lesdites encoches (32) s'étendant depuis ladite lumière jusqu'à ladite surface cylindrique extérieure (25), et un boîtier (12) de contacts ayant un capot (48) présentant une paroi cylindrique intérieure (47) définissant une cavité (51) destinée à recevoir ledit boîtier (10) de fils et plusieurs contacts (42) fixés dans le boîtier de contacts, chacun desdits contacts (42) ayant une partie d'accouplement (60) et une partie de déplacement d'isolant, et ladite partie (64) de déplacement d'isolant pénétrant dans ladite cavité (51) pour une terminaison sur des conducteurs (W) du câble (C) à conducteurs multiples, caractérisé par des moyens d'écartement (23, 53) formés sur le boîtier (10) de fils et le boîtier (12) de contacts pour positionner le boîtier (10) de fils transversalement à l'axe, les moyens d'écartement (23, 53) définissant un espace entre la surface cylindrique extérieure (25) du boîtier de fils et la paroi cylindrique intérieure (47) du boîtier de contacts pour la réception d'extrémités de conducteurs (W) du câble (C) à conducteurs multiples, et des moyens (14) destinés à fixer l'un à l'autre le boîtier (10) de fils et le boîtier (12) de contacts.

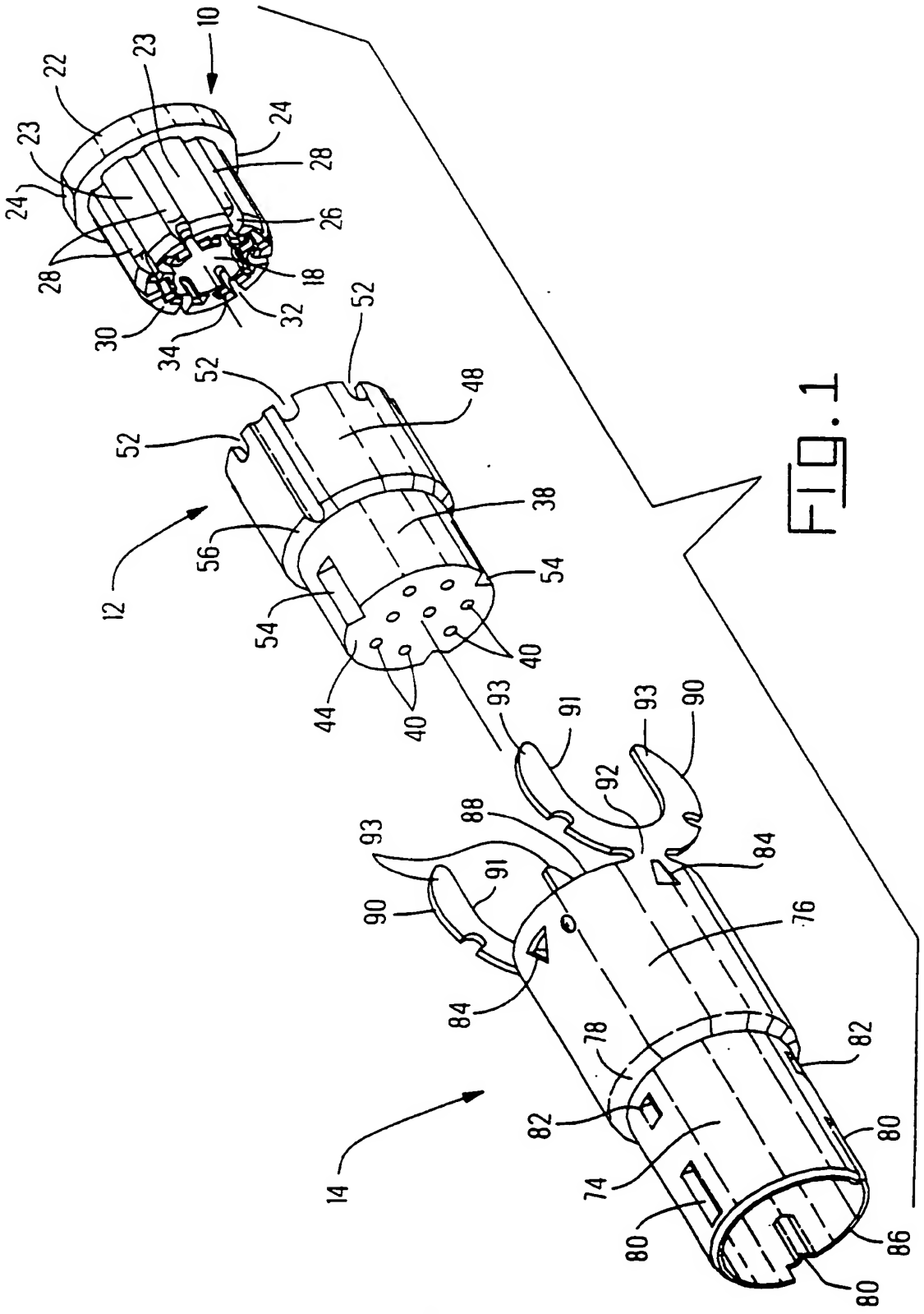
2. Connecteur électrique selon la revendication 1, caractérisé en ce que les moyens d'écartement comprennent des nervures (23) sur la surface extérieure (25) du boîtier (10) de fils, lesdites nervures (23) portant contre la paroi intérieure (47) du boîtier (12) de contacts lors d'une insertion du boîtier (10) de fils dans la cavité.

3. Connecteur électrique selon la revendication 1 ou 2, caractérisé en ce les moyens d'écartement (23, 53) comprennent des nervures (53) dirigées radialement vers l'intérieur, faisant saillie de la paroi intérieure (47) du boîtier 12 de contacts, lesdites nervures (53) dirigées vers l'intérieur portant contre la surface extérieure (25) du boîtier (10) de fils lors d'une insertion du boîtier 10 de fils dans la cavité (51).

4. Connecteur électrique selon la revendication 2 ou 3, caractérisé en ce que des nervures adjacentes (23, 53) définissent entre elles des moyens à canaux conçus pour recevoir une extrémité d'un conducteur (W) du câble (C) à fils multiples, chacun de ces moyens à canaux croisant une encoche associée (32).

5. Connecteur électrique selon la revendication 1, 2 ou 3, caractérisé en ce que le boîtier (10) de fils présente des évidements (28) de réception de fils dans ladite surface extérieure (25), lesdits alignements (28) de réception de fils s'étendant parallèlement audit axe et croisant lesdites encoches (32) à l'une de leurs extrémités.

6. Connecteur électrique selon l'une quelconque des revendications précédentes, caractérisé en ce que les moyens destinés à fixer l'un à l'autre le boîtier 10 de fils et le boîtier 12 de contacts comprennent une coque 14 de blindage.


10
22
23
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18
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34
52
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12
14
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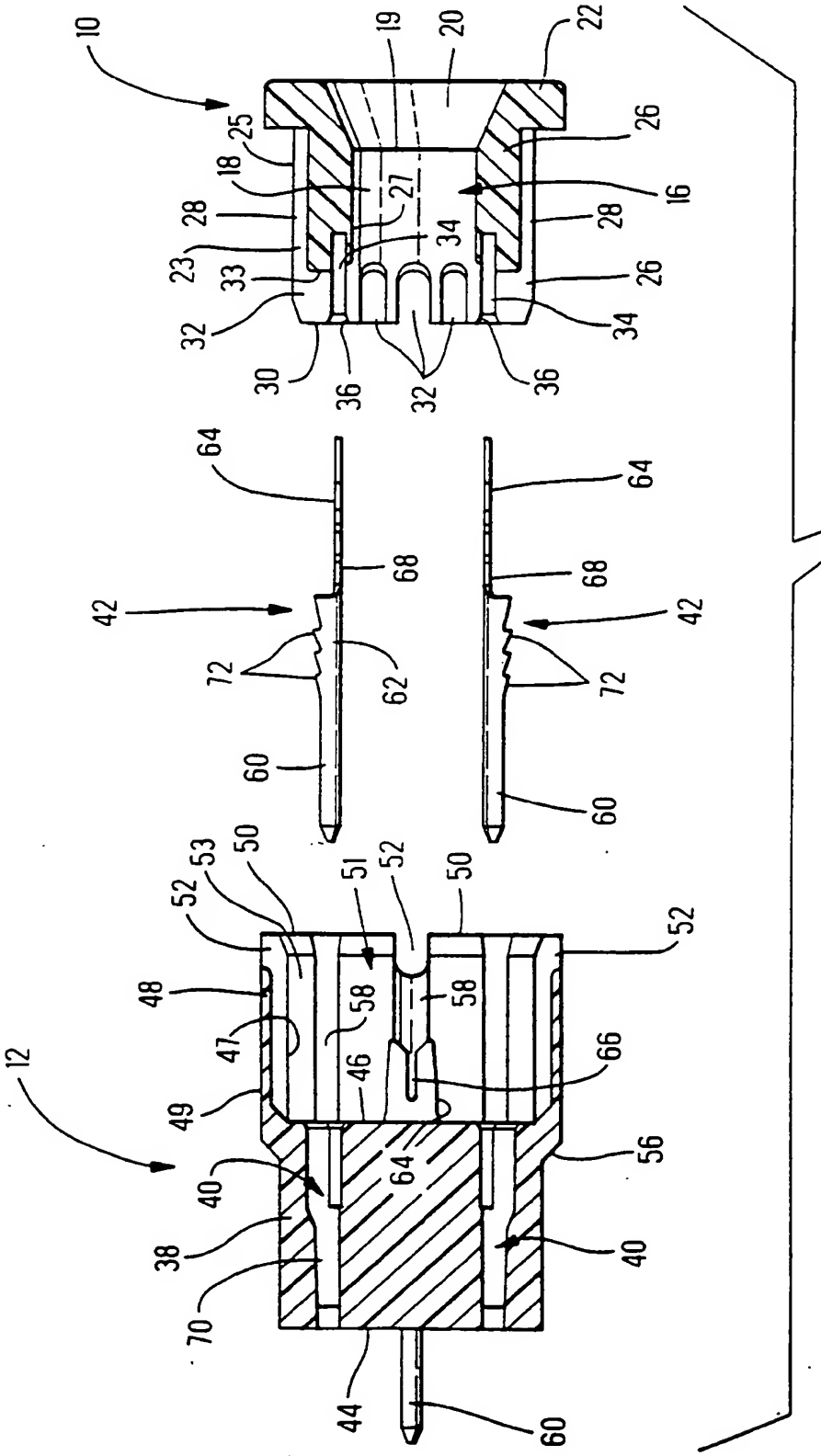
74
80
86

FIG. 1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19
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16
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64
64
68
68
42
42
72
62
72
60
60
50
53
52
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52
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47
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66
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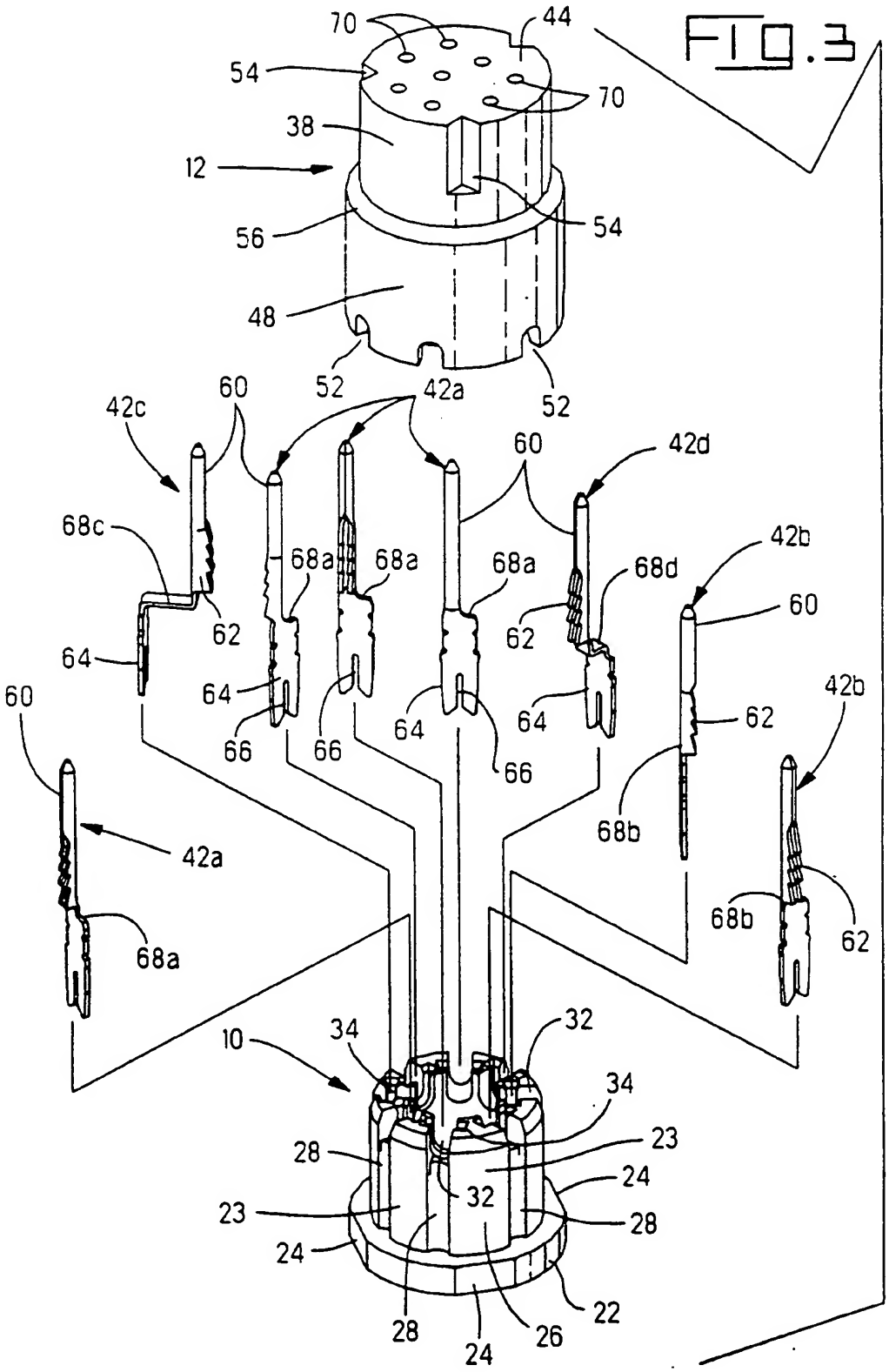
12
56
64
40
40
38
70
44
60

FIG.2

FIG.3


70
44
54
70
38
12
56
54
48
52
52
42c
60
42a
60
42d
68c
68a
68a
68a
68d
42b
62
62
60
64
64
64
64
60
42b
66
66
66
62
42a
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22
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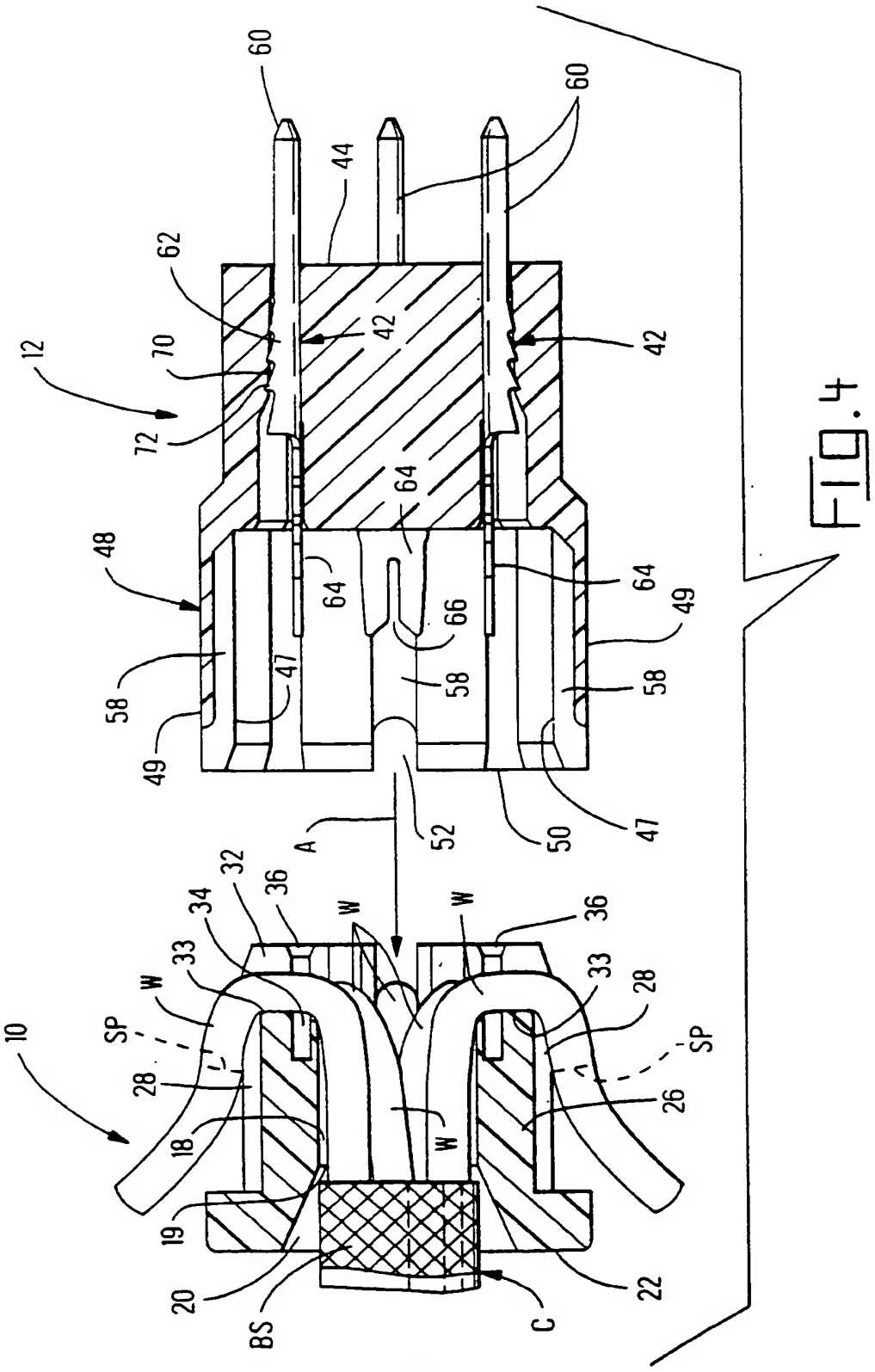
24
26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60
44
62
42
42
12
70
72
64
48
64
64
66
49
58
47
58
58
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A
52
50
47
32
36
34
W
W
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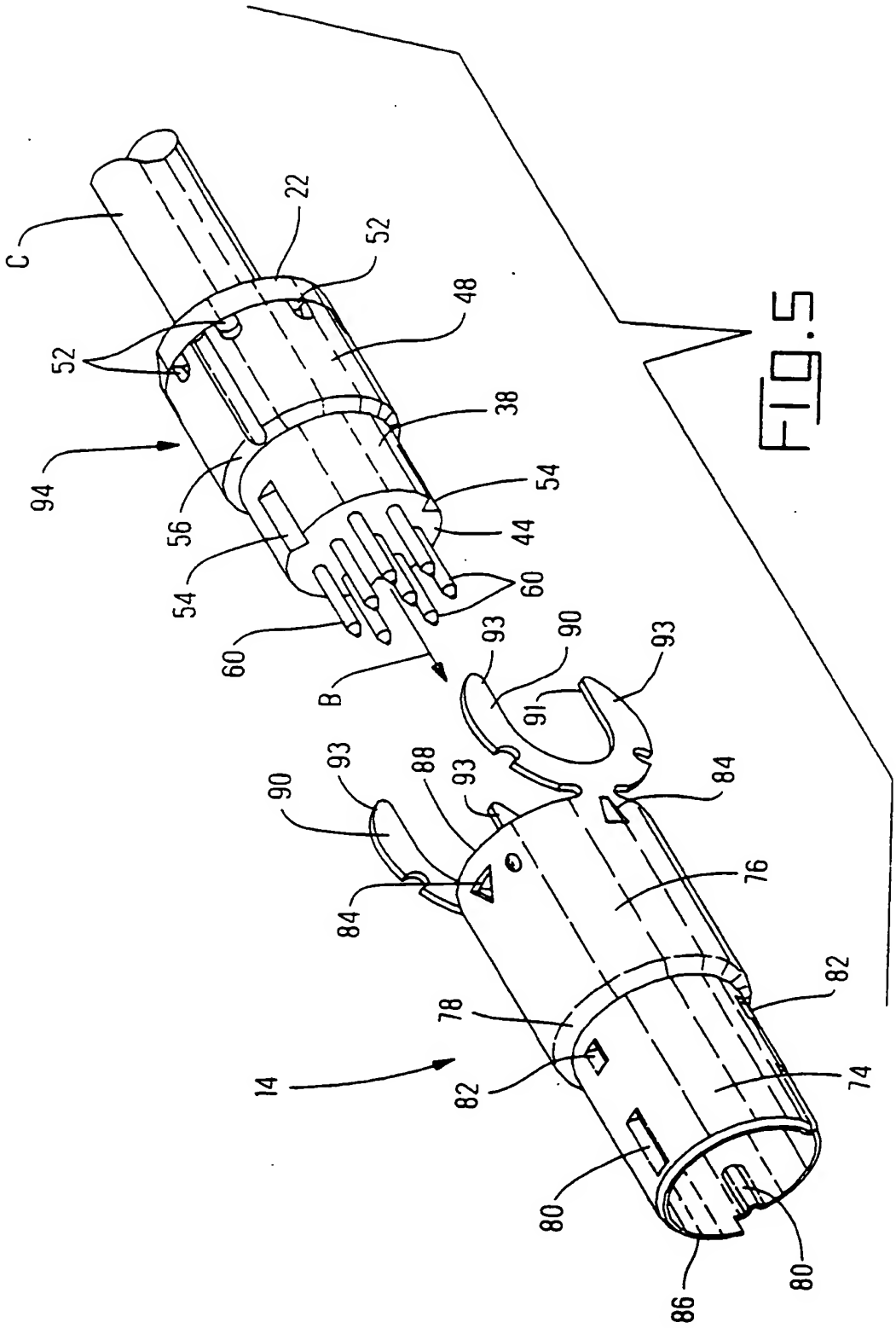
W
28
SP
SP
28
26
10
18
W
19
20
BS
C
22

FIG. 4


C
22
52
52
48
38
94
56
54
44
54
60
60
B
93
90
93
91
93
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84
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82
78
14
82
74
80
80
86

FIG.5

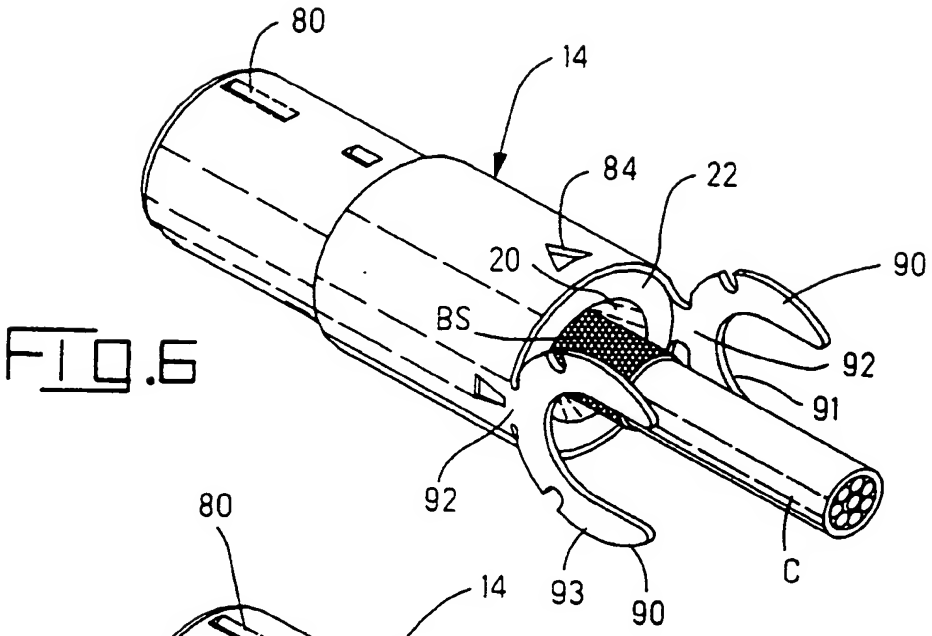


FIG.6

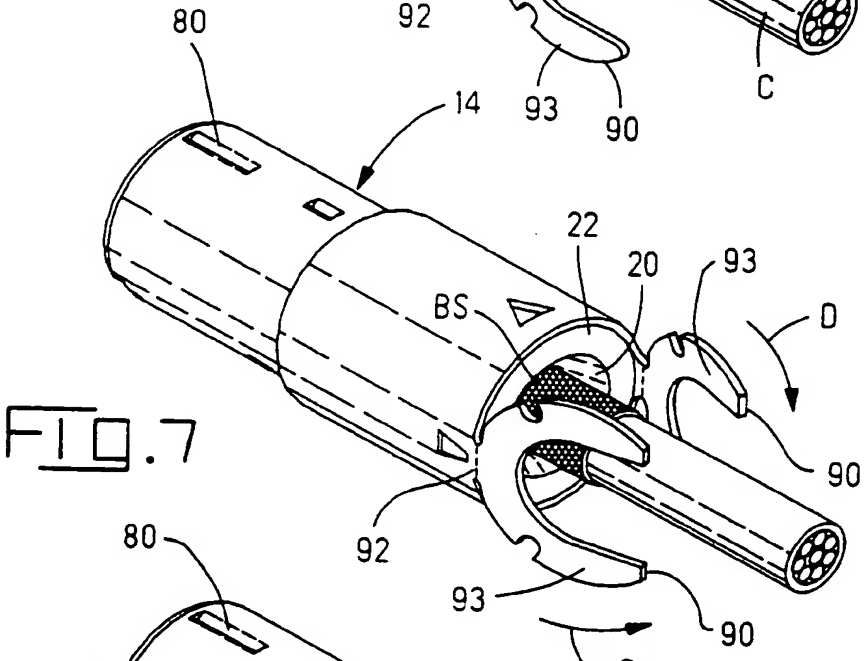


FIG.7

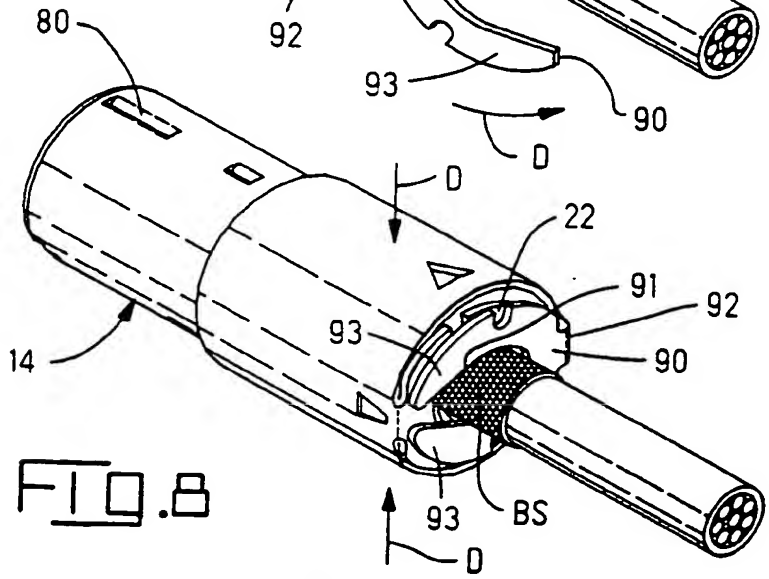


FIG.8

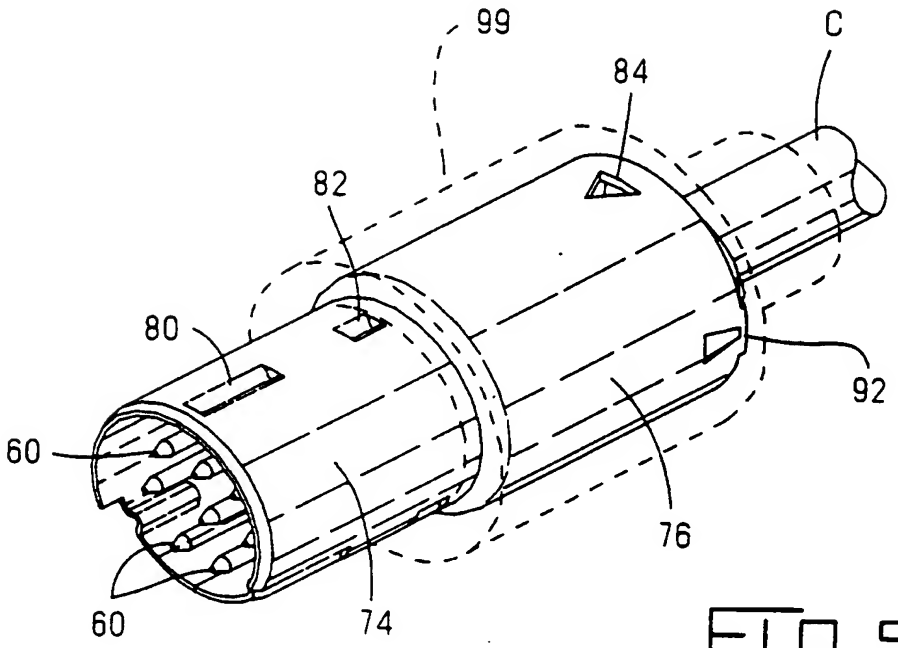


FIG.9

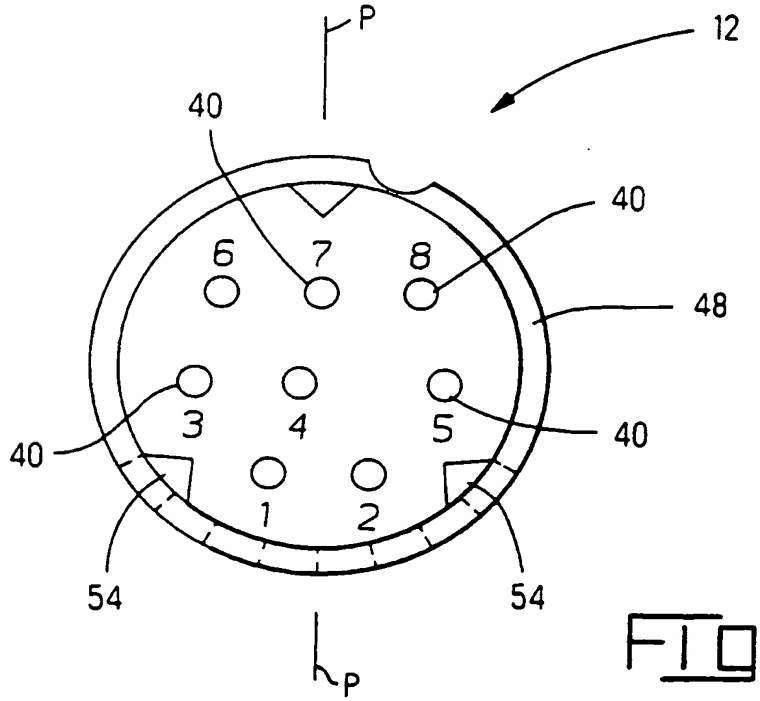


FIG.10

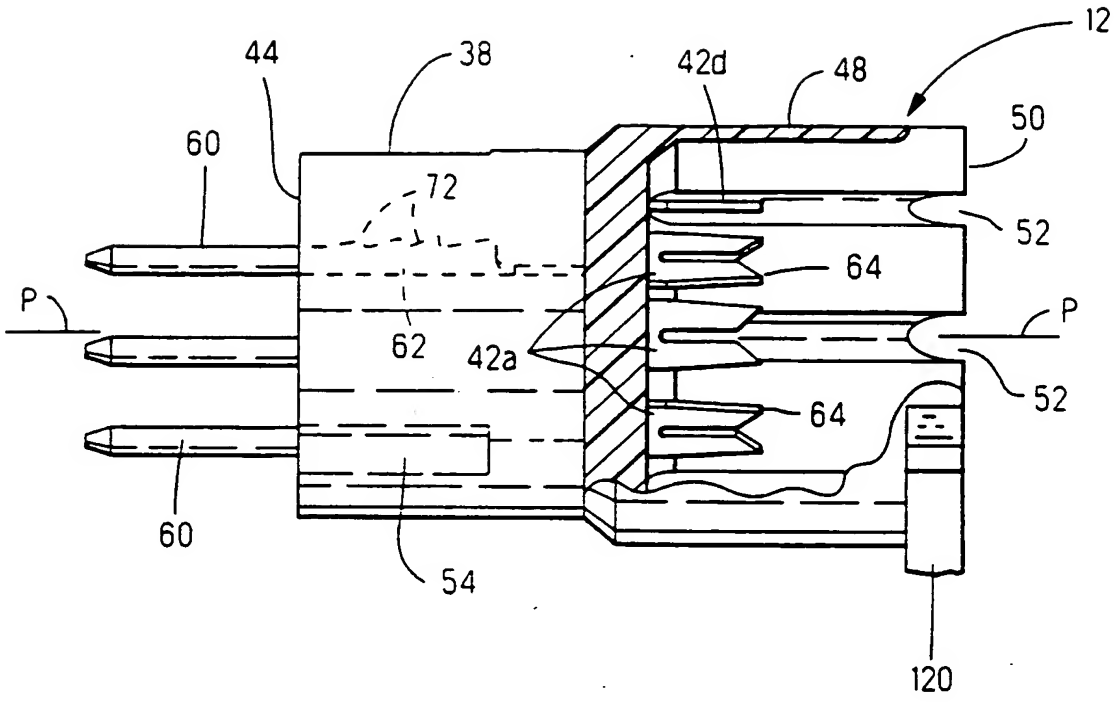
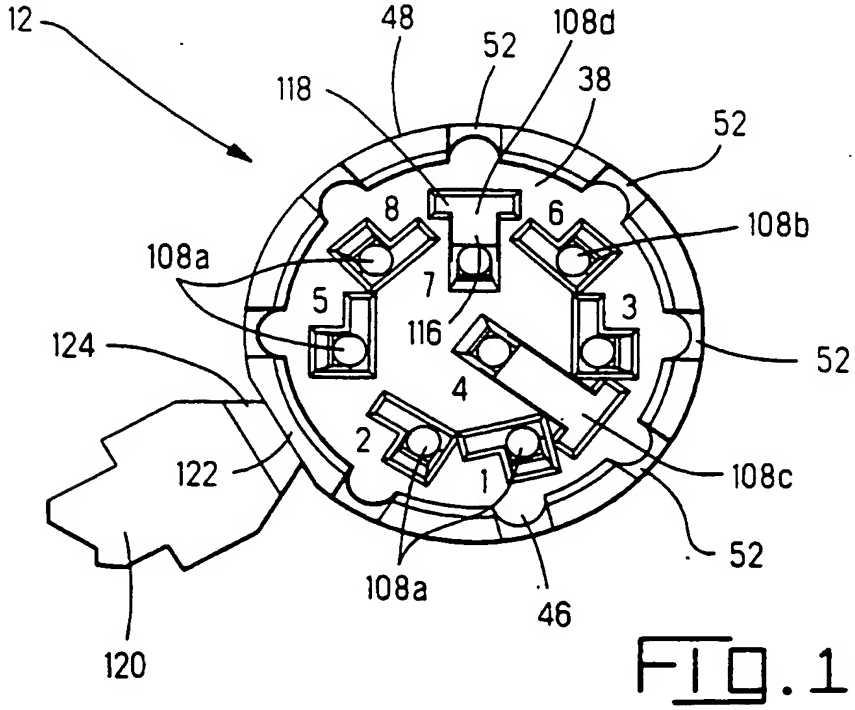

12
44
38
42d
48
50
60
72
52
64
P
62
42a
P
52
64
60
54
120

FIG. 11


12
48
52
108d
118
38
52
8
6
108b
108a
7
5
3
116
124
52
4
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122
1
108c
52
108a
46
120

FIG. 12

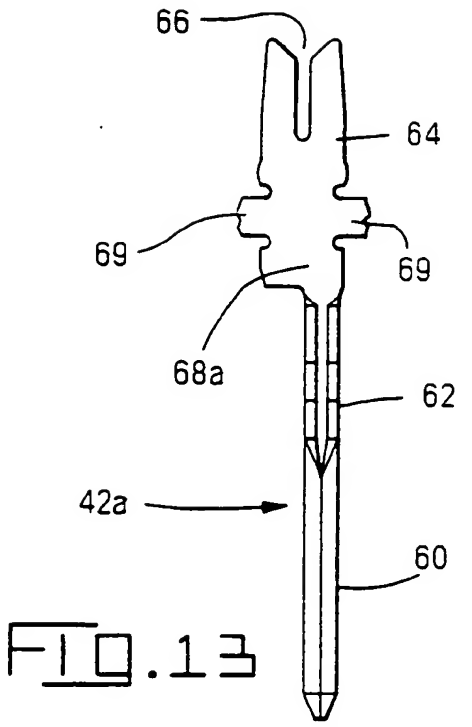


FIG.13

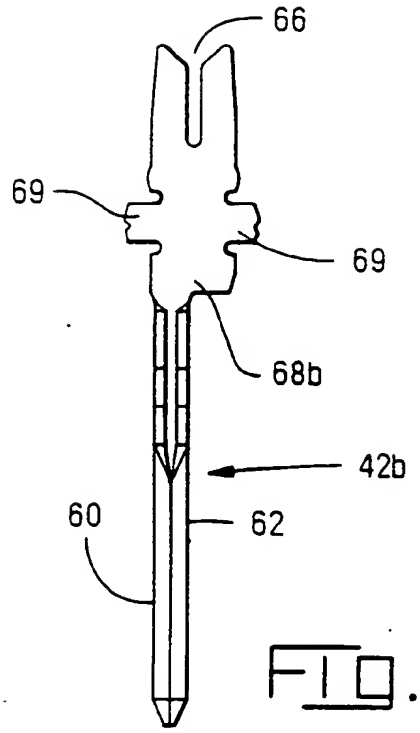


FIG.14

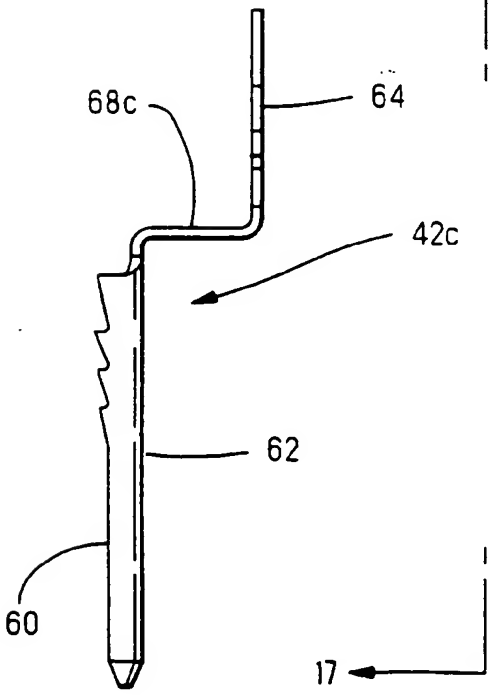


FIG.15

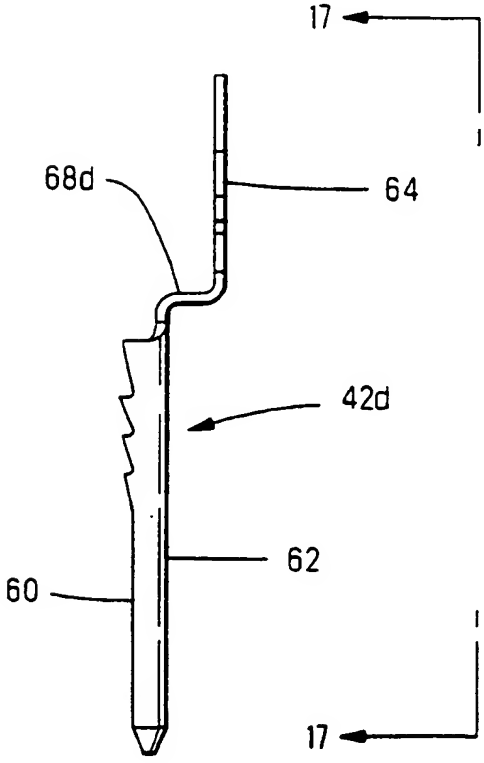


FIG.16

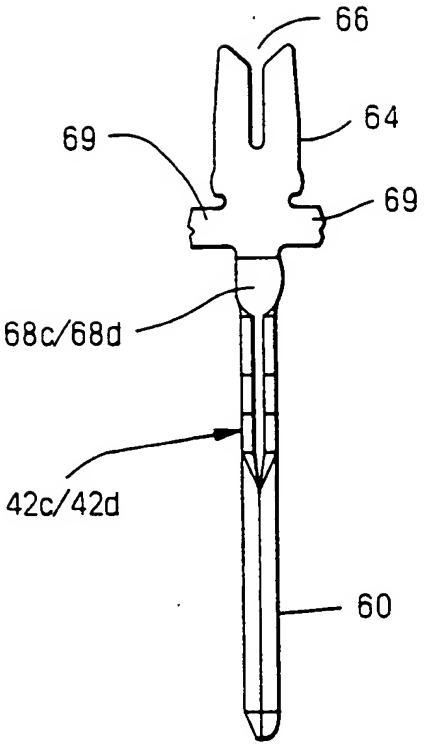


FIG.17

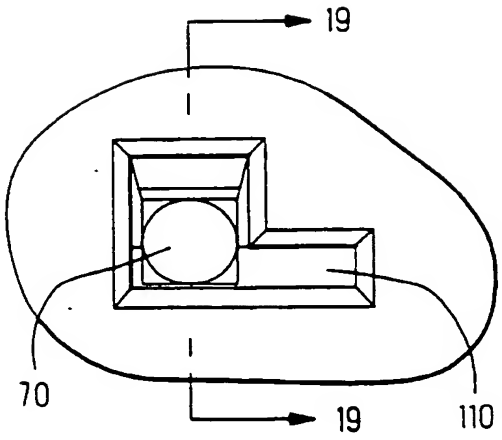


FIG.18

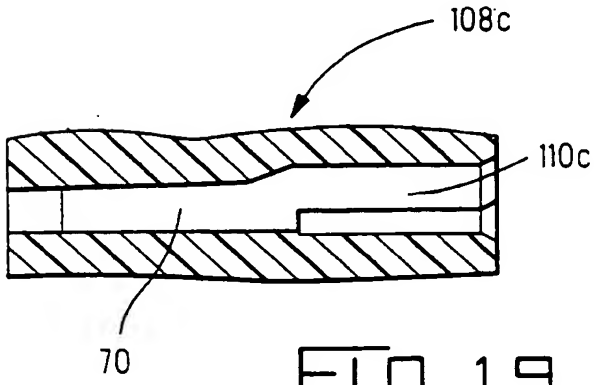


FIG.19

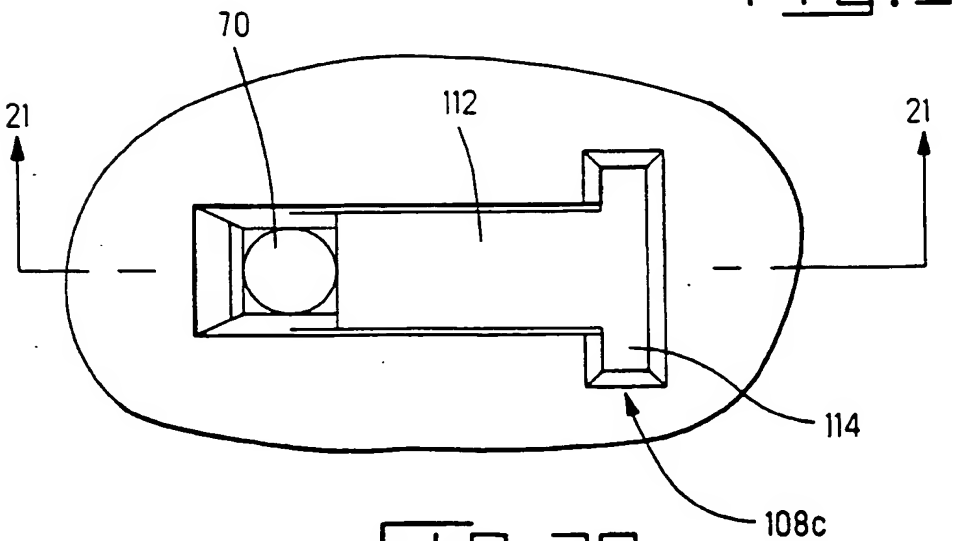


FIG.20

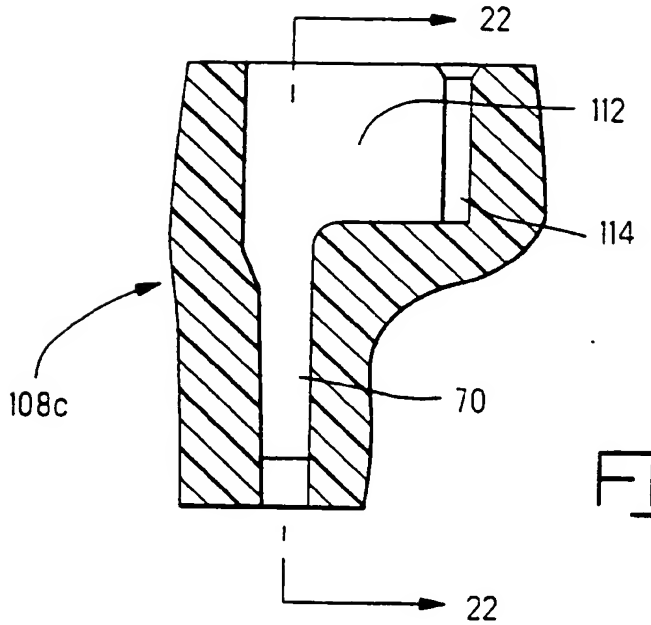


FIG.21

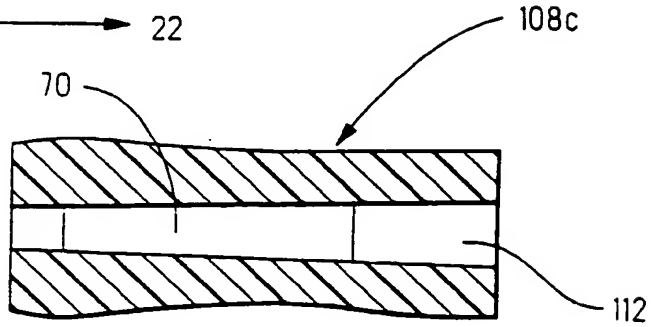


FIG.22

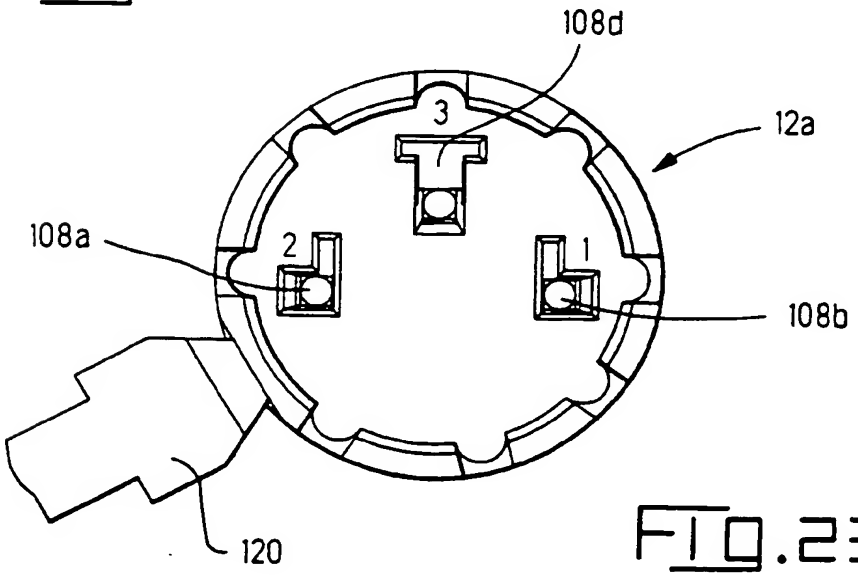


FIG.23

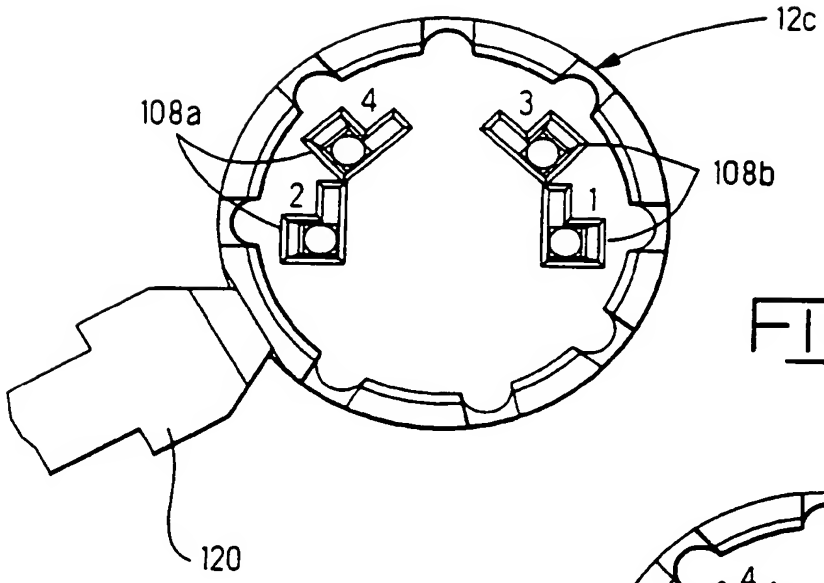


FIG. 24

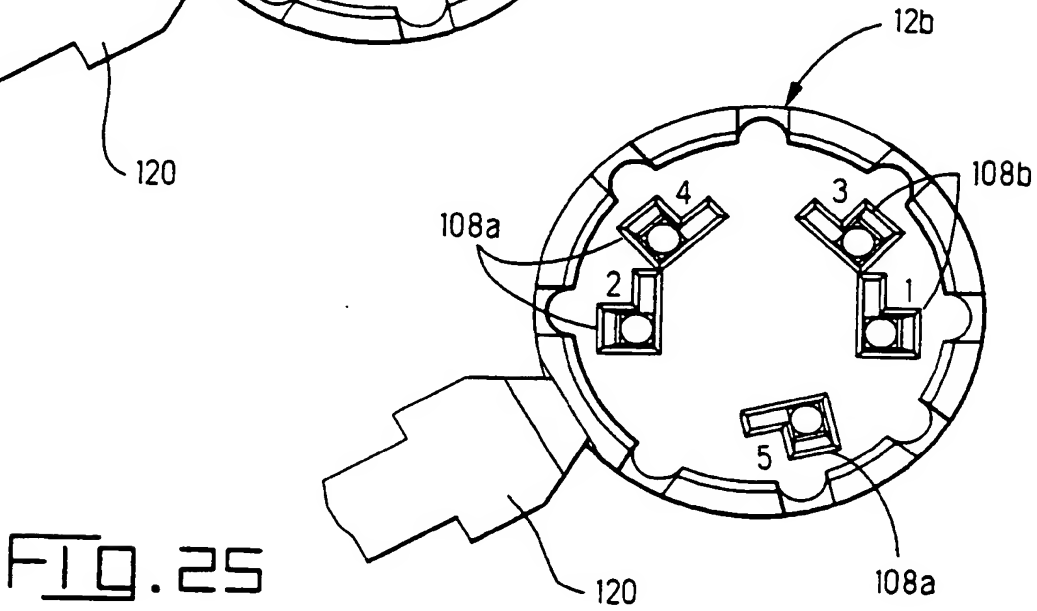


FIG. 25

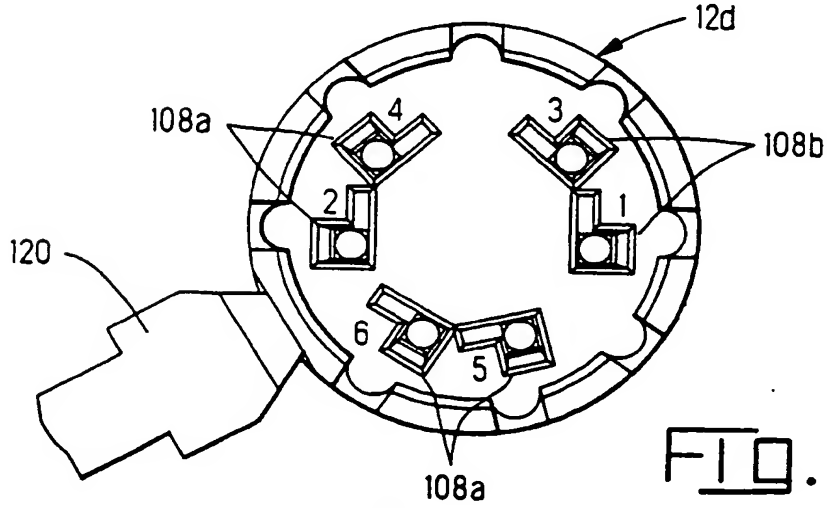


FIG. 26

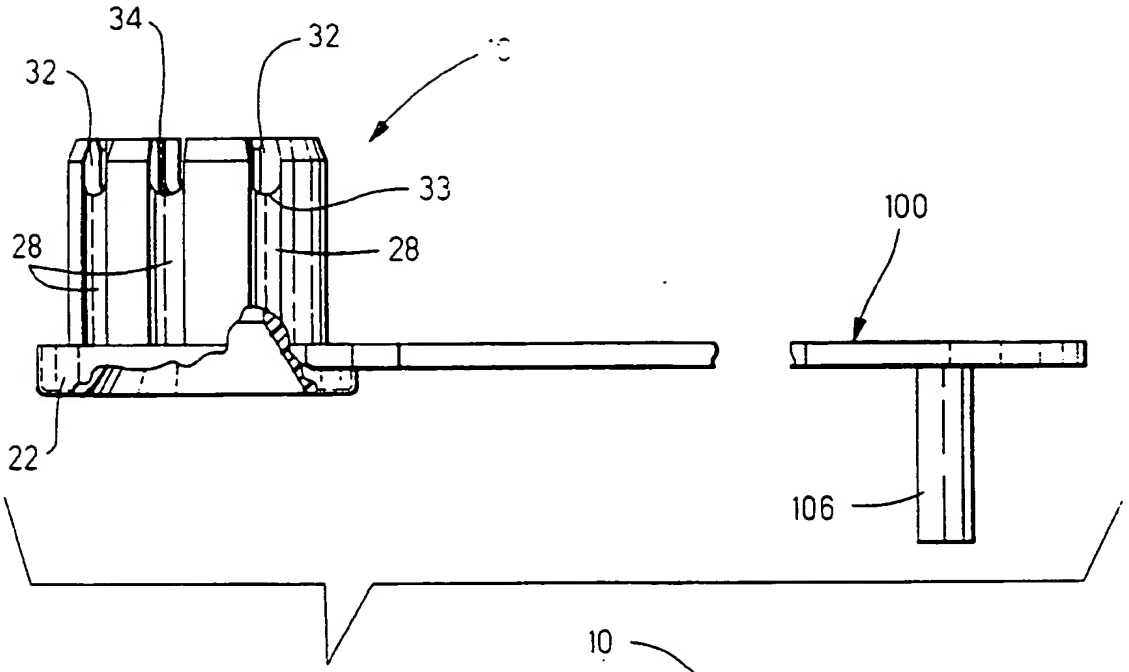
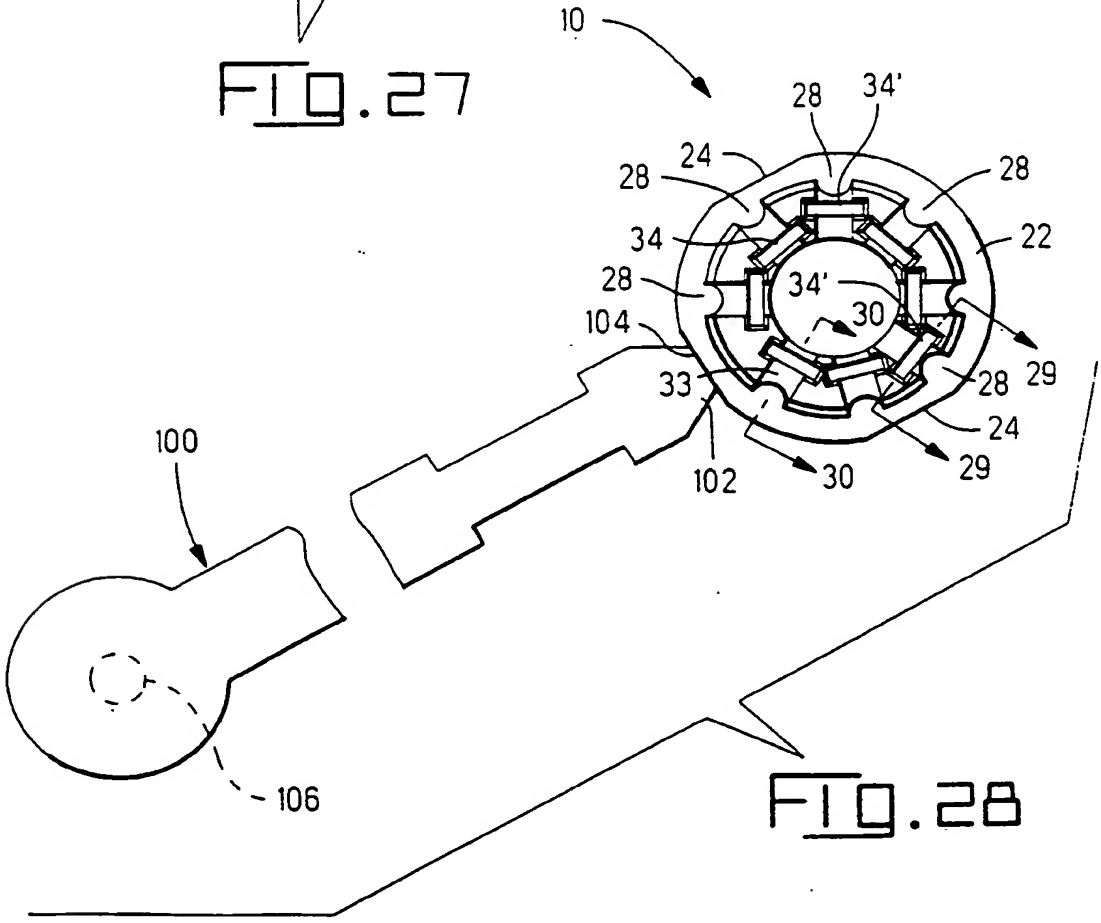

34
32
32
33
28
28
22
100
106

FIG.27


10
28
34'
24
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28
22
34
28
34'
30
104
33
28
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24
29
30
102
100
106

FIG.28

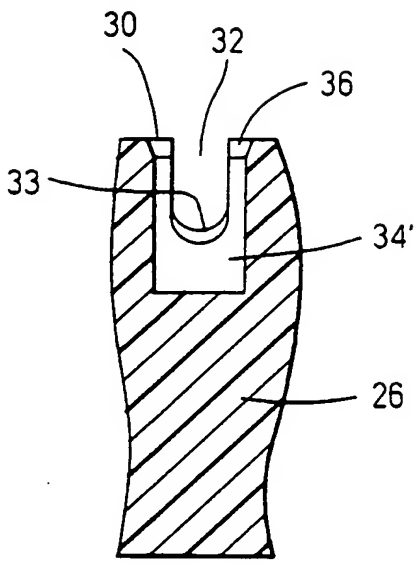

FIG.29

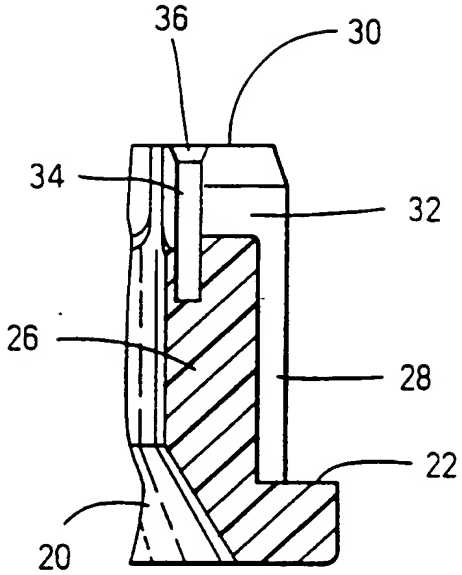

FIG.30

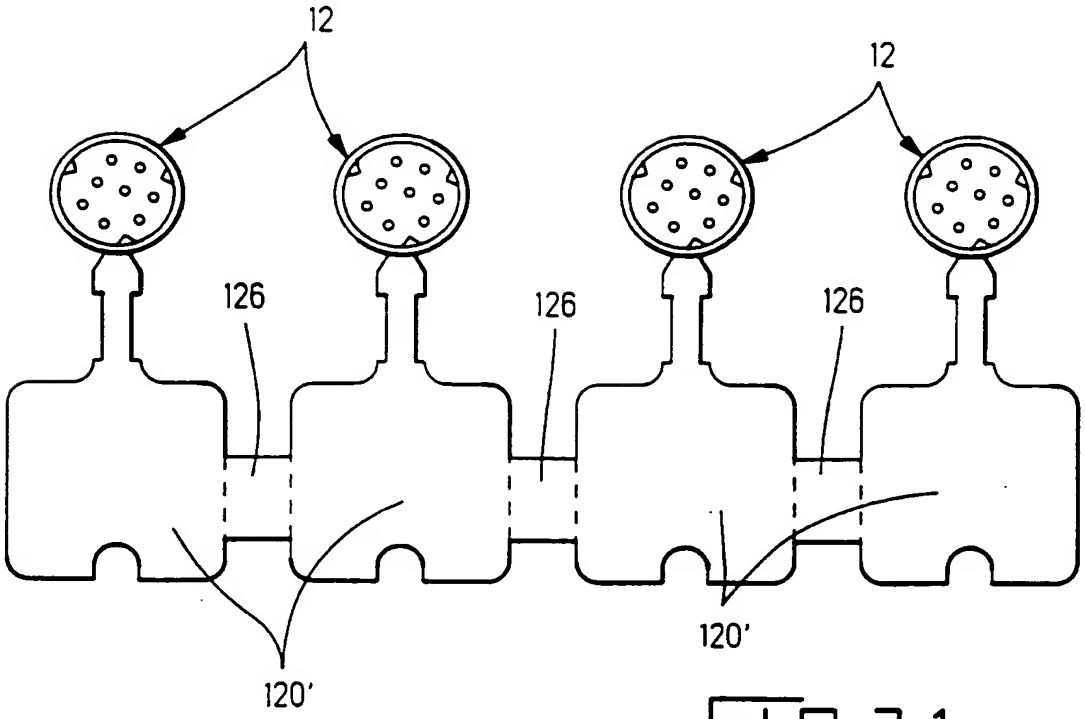

FIG.31

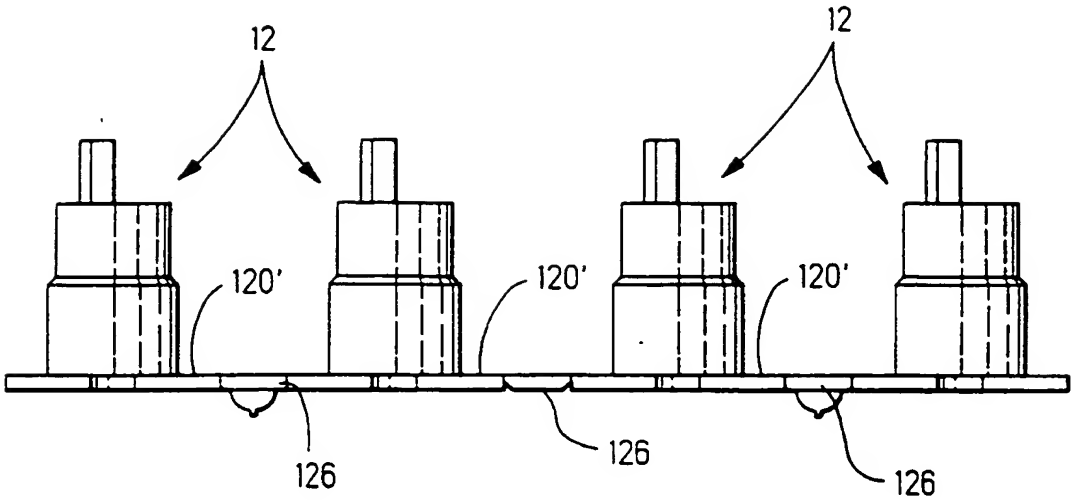

FIG.32

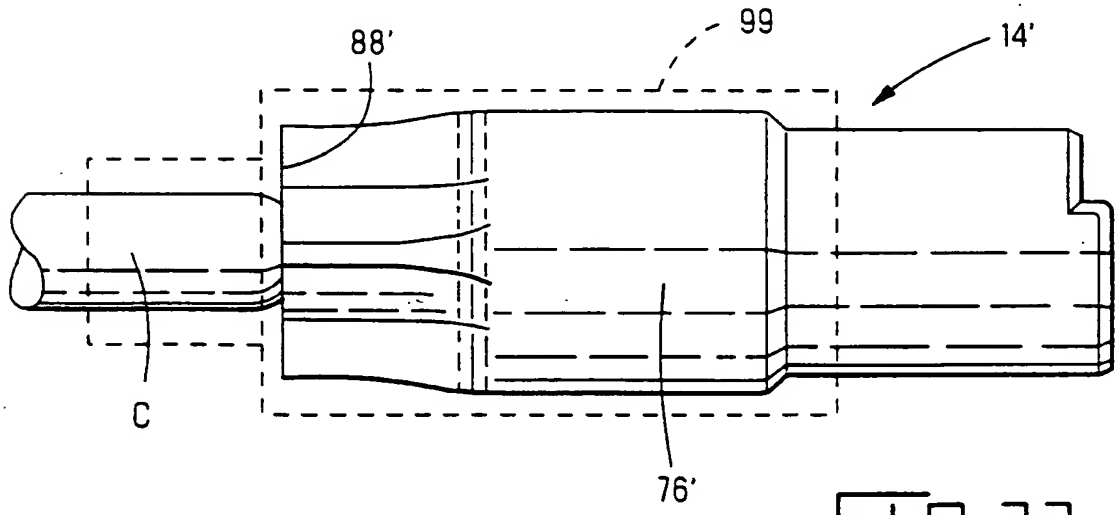

FIG.33

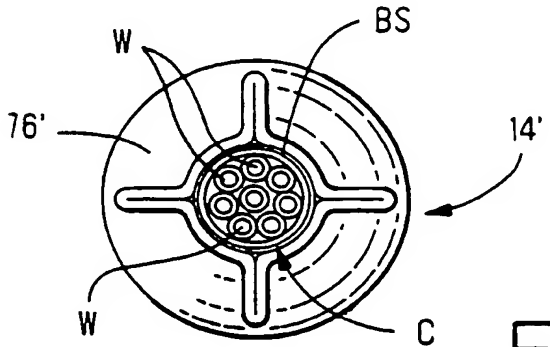

FIG.34

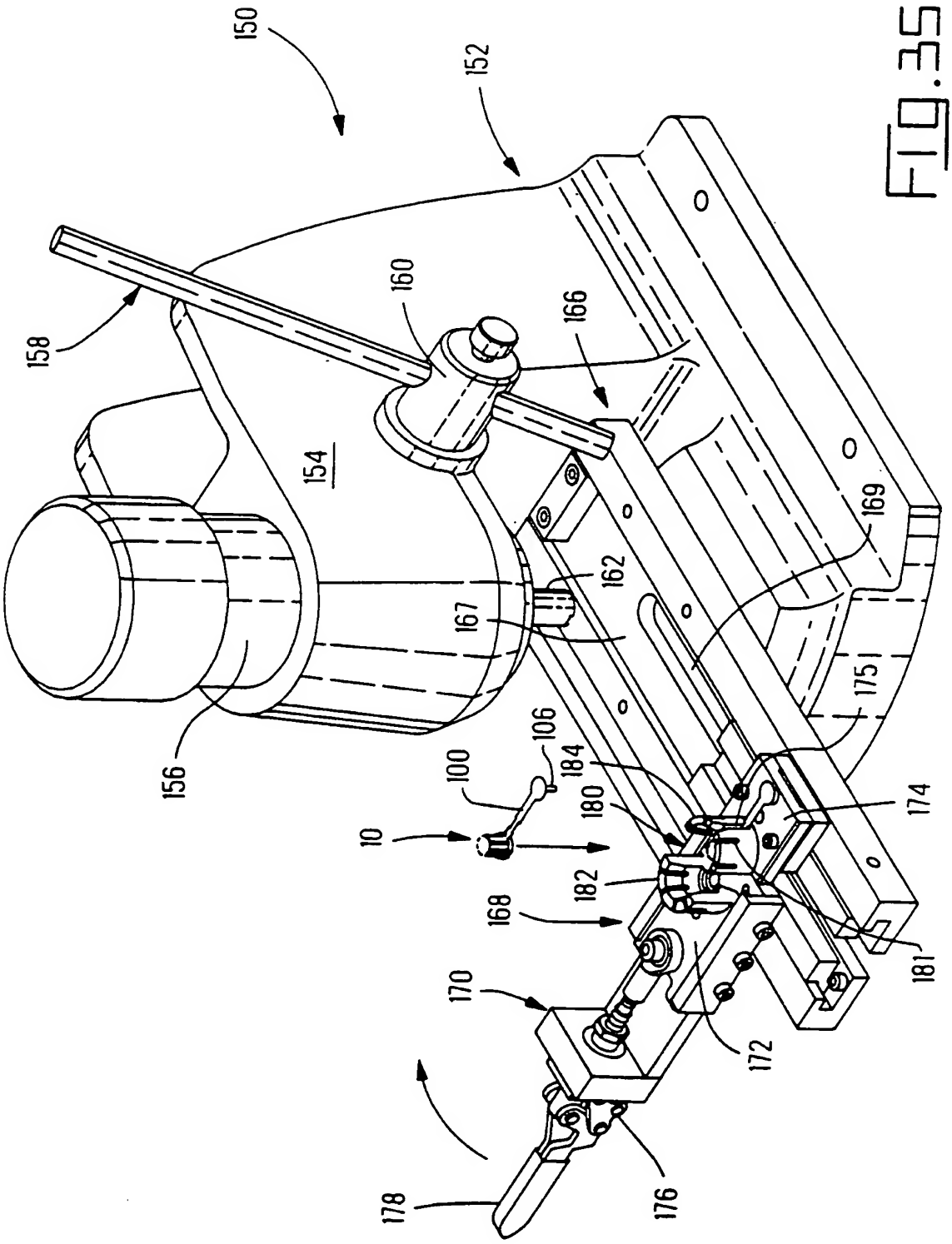
150
152
158
160
166
154
169
162
167
175
156
106
100
184
180
174
10
182
168
181
170
172
178
176

FIG.35

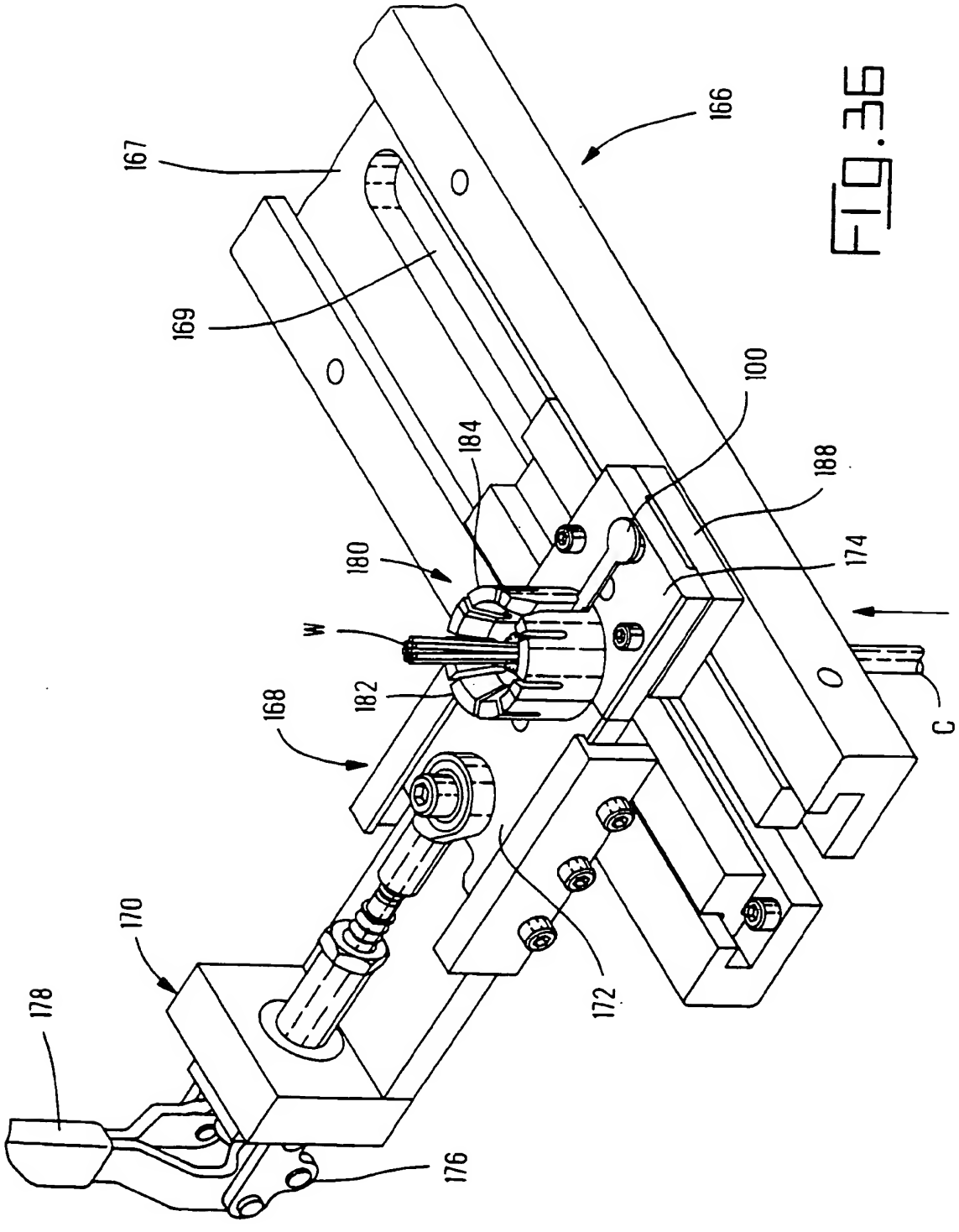

FIG.36

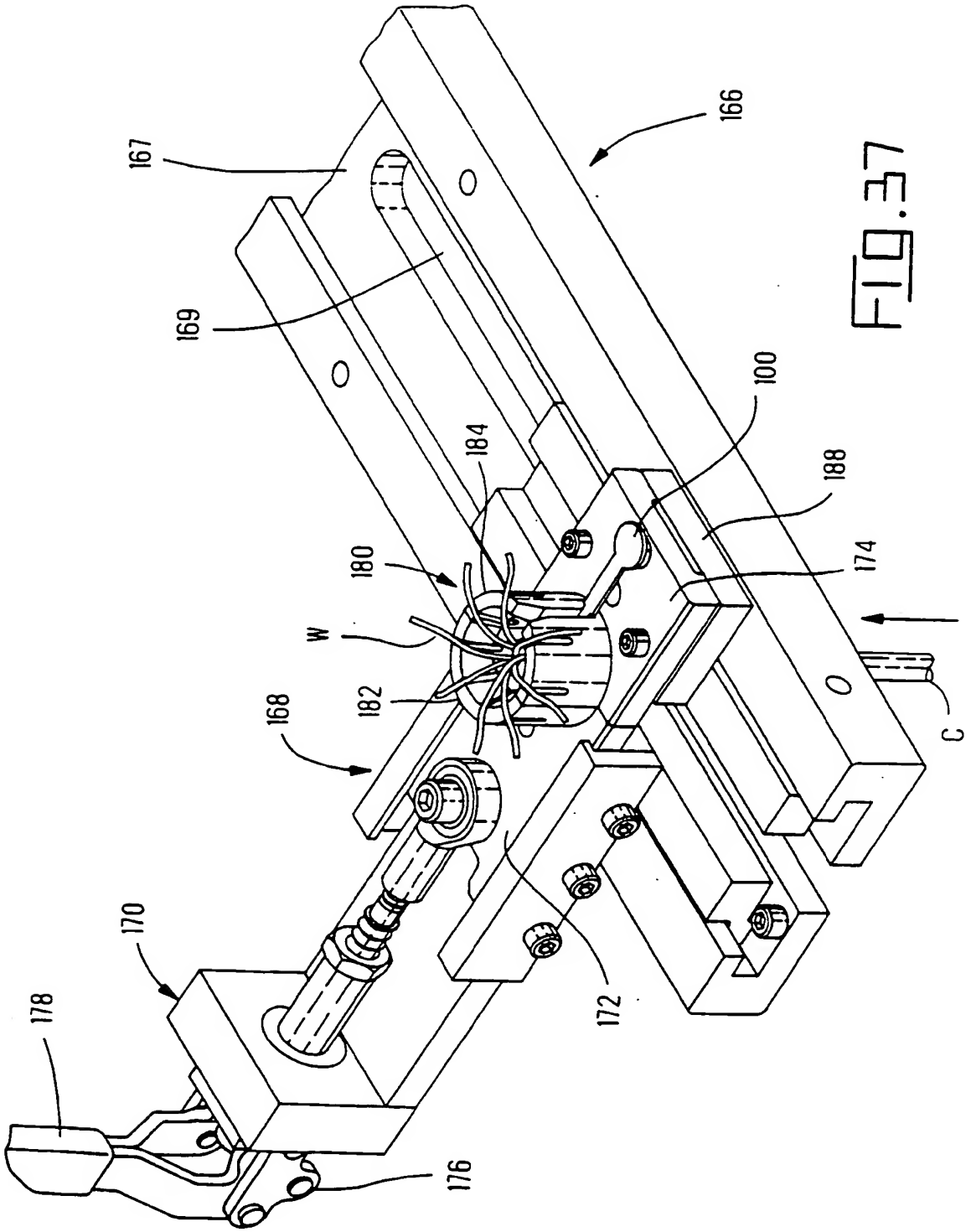

FIG.37

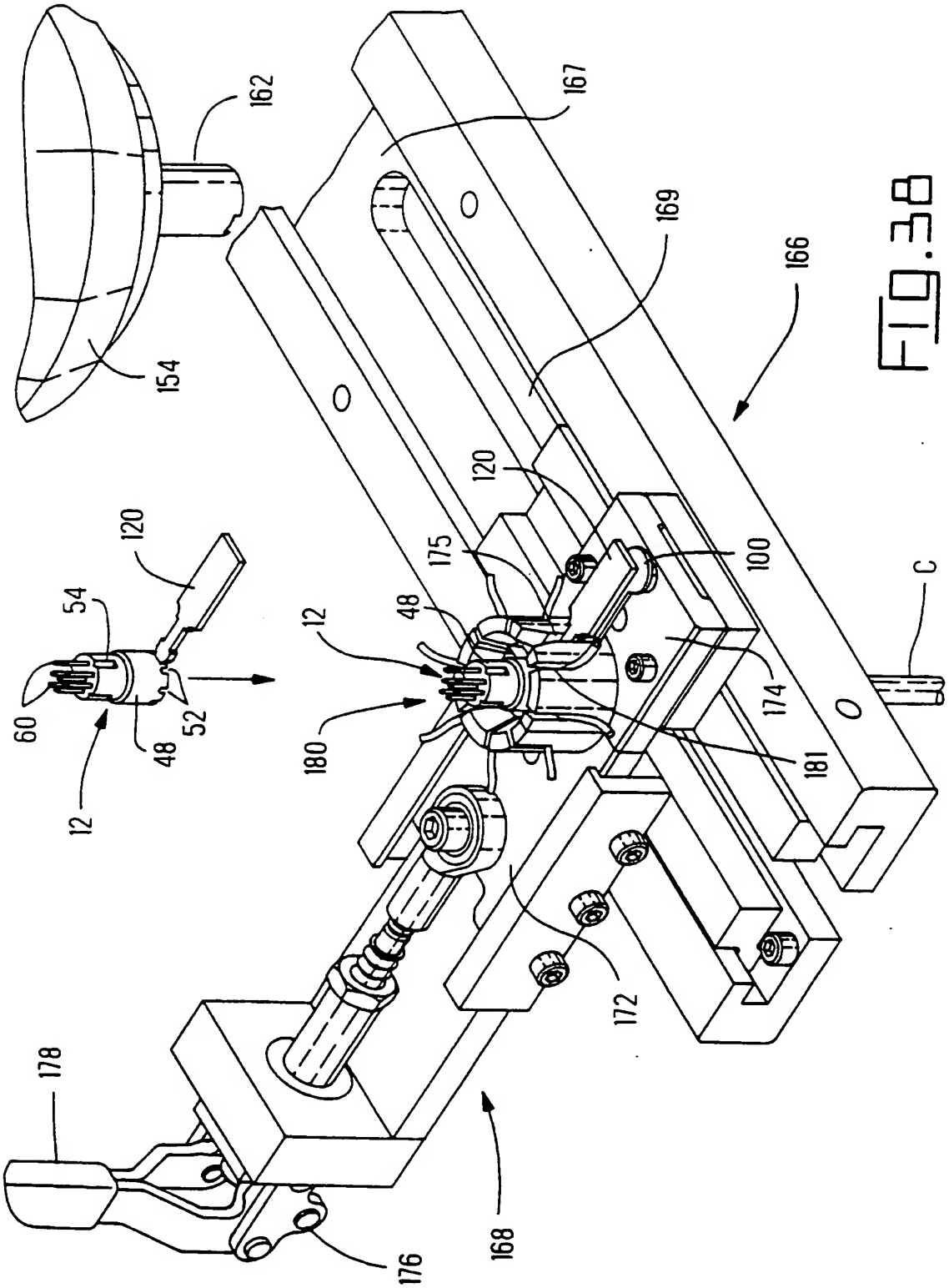
162
154
167
169
166
120
175
100
C
48
12
174
180
181
54
120
60
52
48
12
172
178
176
168

FIG.38

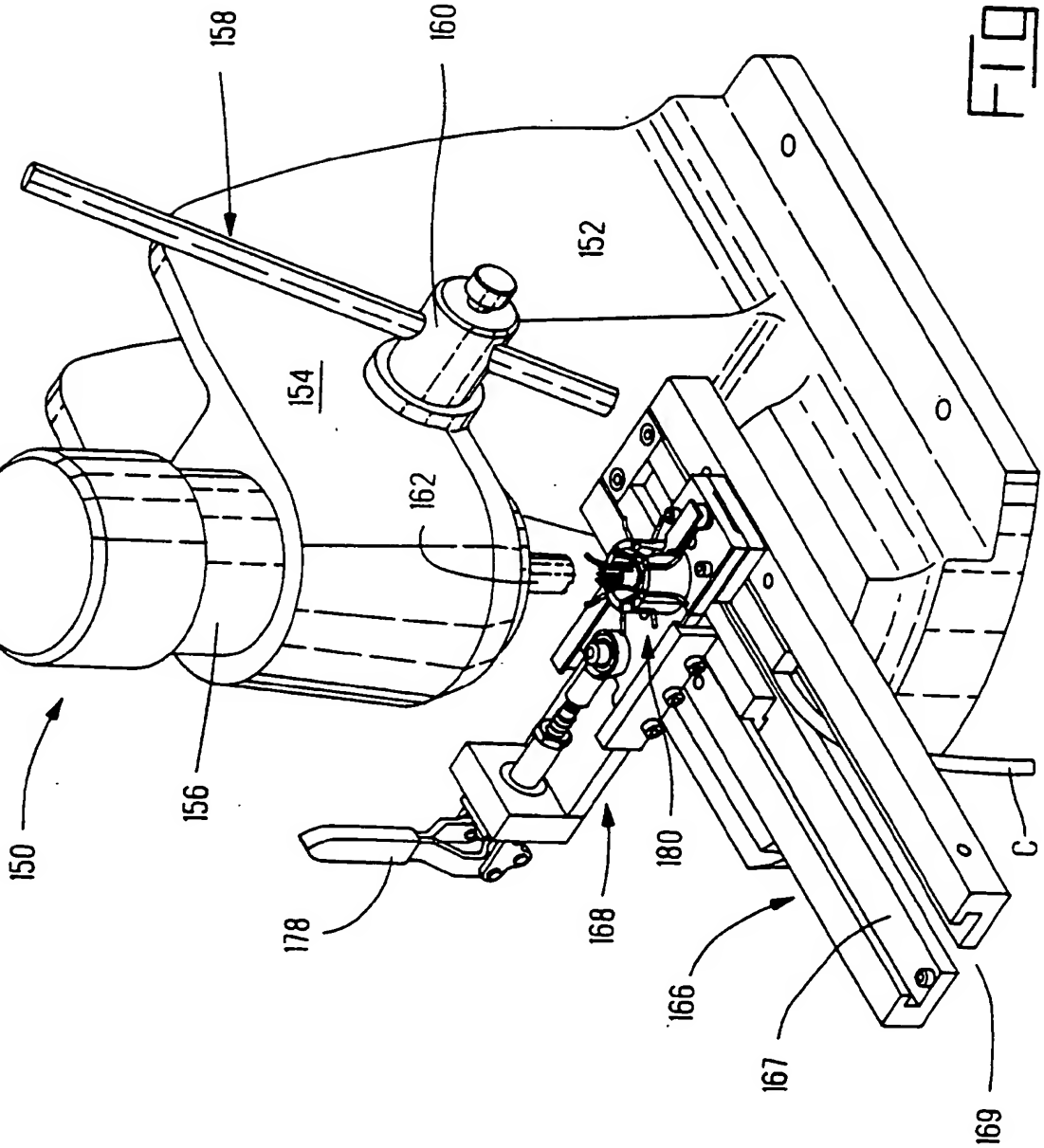

FIG.39

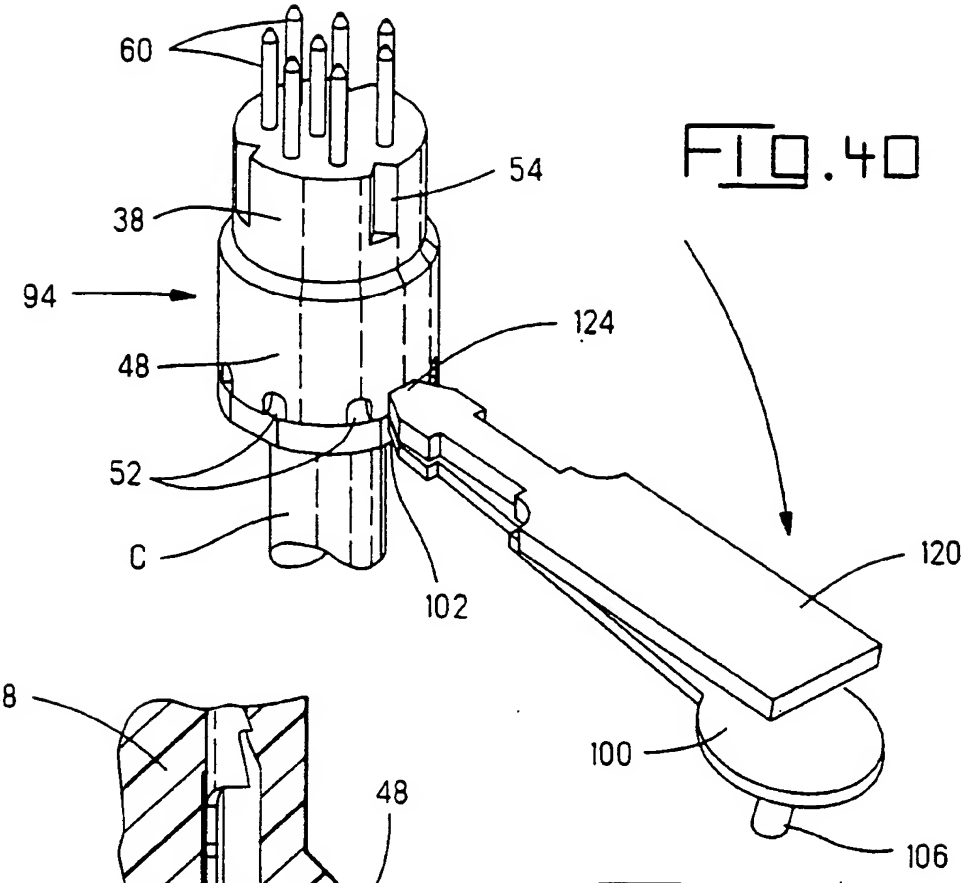
60
54
38
94
124
48
52
C
102
120
100
106

FIG.40

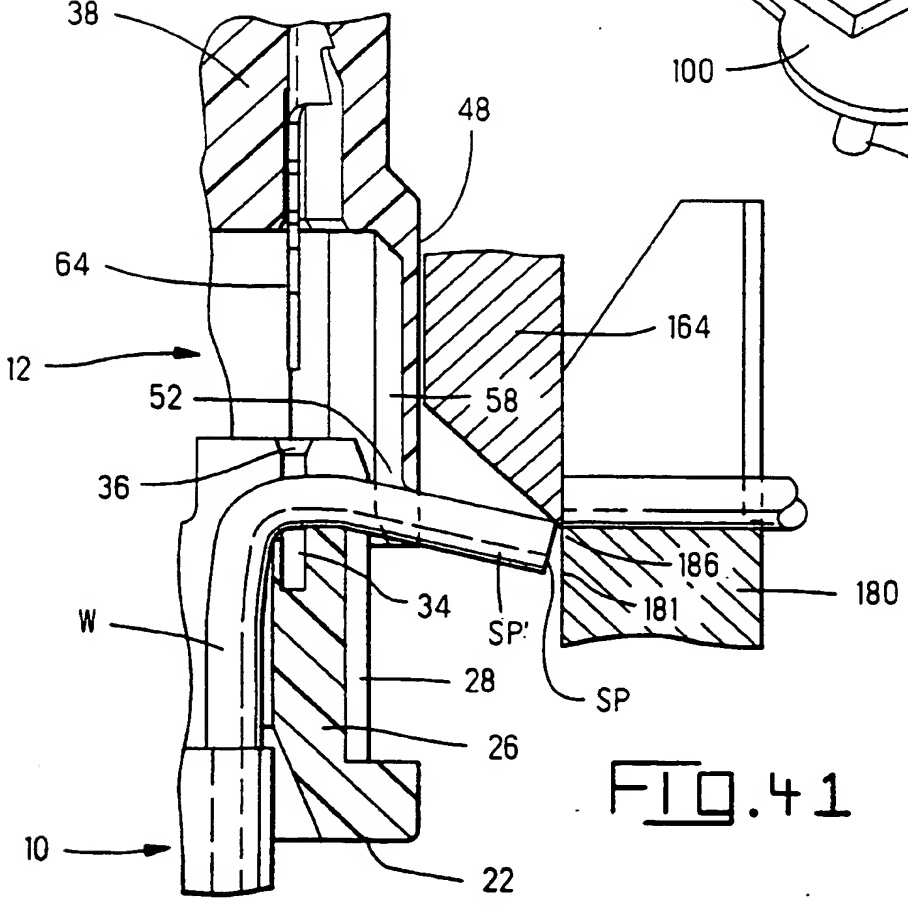
38
48
64
164
12
52
58
36
186
180
34
181
SP'
W
28
SP
26
10
22

FIG.41

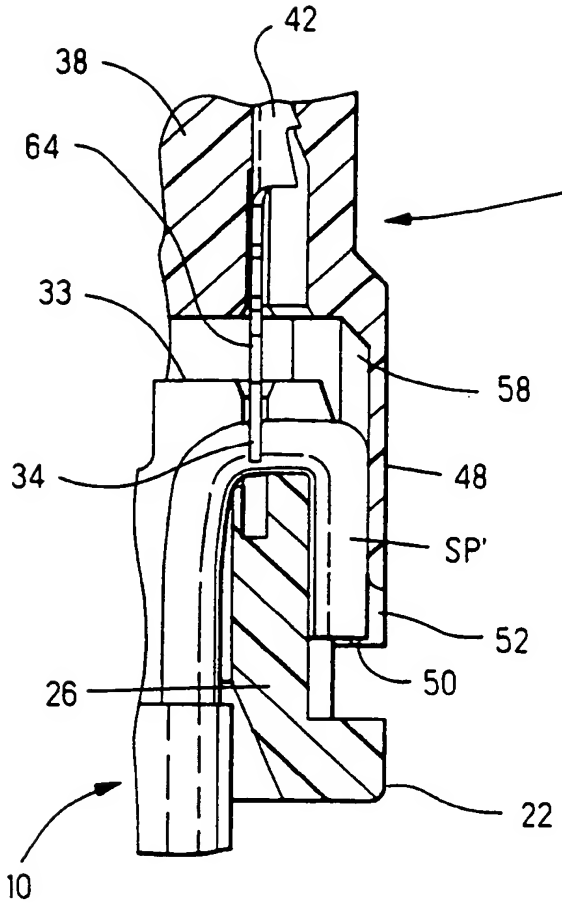
42
38
64
12
33
58
34
48
SP'
52
50
26
22
10

FIG.42

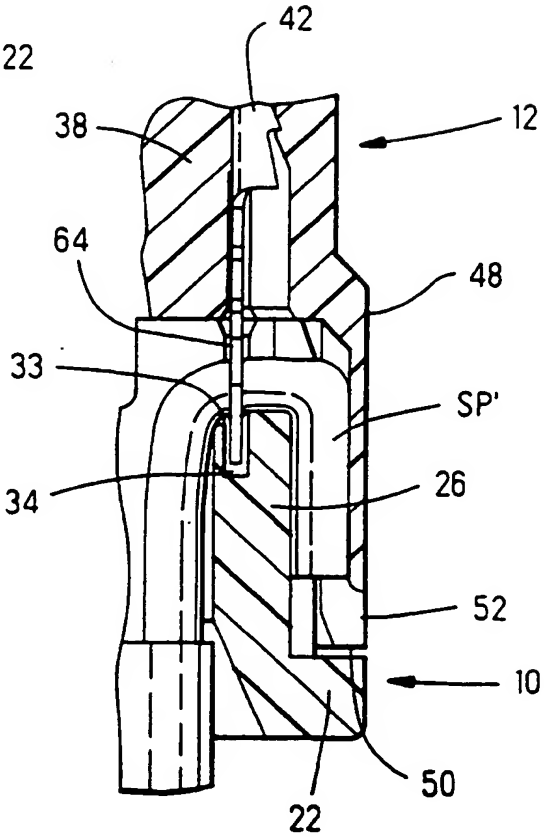
42
38
12
64
48
33
SP'
34
26
52
10
50
22

FIG.43